THE USE OF INDIRECT TESTS IN THE EVALUATION OF MALINGERED OR EXAGGERATED MEMORY PERFORMANCE

By

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Claims of amnesia and anterograde memory impairment arise in a variety of medicolegal contexts. This study examined the performance of normal subjects given the instructions to malinger or feign memory dysfunction (Malingerers) on various clinical, two-item forced-choice, and indirect memory tests. Normal subjects performing to the best of their ability (Genuine subjects) and patients having sustained a closed head injury with resulting neuropsychological memory impairment served as the comparison groups. The results indicated that Malingering subjects lowered their quantitative level of performance and altered the qualitative aspects of their performance relative to the Genuine subjects. However, Malingering subjects produced performance profiles on clinical memory tests which were highly similar to those of the Head

Injured patients with documented neurological damage and bona-fide neuropsychological memory impairment. In general, no single clinical memory test or combination of several tests proved useful in diagnosing experimental malingering.

Word stem completion and perceptual identification, two commonly used indirect memory tests, were administered to these subject groups with the general idea that Malingering subjects might first experience explicit memory for study items and then engage in postretrieval suppression of correct responses. This general prediction did not hold up in that Malingering subjects produced normal strength of priming and levels of processing effects on both indirect memory tests. However, the results indicated that the Genuine subjects used explicit memory to increase their strength of priming on word stem completion but not on perceptual identification.

In contrast to the indirect memory tests, the Symptom Validity Testing paradigm used in this study was designed as a direct test of short-term memory. The "art" of SVT lies in the fact that expected performance levels are not apparent to the typical subject. The main finding concerning the SVT paradigm was that Malingering subjects, as a group, were impaired relative to other groups, but scored well above chance levels and demonstrated surprisingly consistent responding across trials. Several statistical methods demonstrated that the traditional criterion of chance performance may be potentially insensitive to malingering response sets.

CHAPTER 1
INTRODUCTION

Claims of amnesia arise in a variety of medicolegal contexts (Wiggins & Brandt, 1988), especially in cases involving violent crime (Bradford & Smith, 1979). In one review, malingered amnesia was found to be the most frequently alleged mental defect (Hopwood & Snell, 1933). Hopwood and Snell (1933) highlight the utility of malingering amnesia for a defendant on trial in a criminal proceeding. They relate a story of a defendant who, after claiming amnesia for an alleged murder, has escaped the responsibility for his crime and finds himself confined to an asylum instead of a prison. He quickly realizes that a persistence of amnesia for his crime will keep him confined in an asylum and then suddenly recovers his forgotten memories. This scenario highlights the volitionality and goal-orientation of malingering. It is also common for claims of amnesia to arise in civil proceedings (Benton & Spreen, 1961), such as personal injury suits and disability hearings (Guthkelch, 1980).

The determination of the genuineness of claimed amnesia will often have a profound impact upon the outcome of legal proceedings. If a claim of amnesia is judged to be malingered, it can no longer be used to support a defendant's plea for automatism (i.e., performance of acts without awareness or

conscious volition), may result in a partial reduction in, or elimination of, monetary damages for the plaintiff, and could no doubt discredit other testimony delivered by the malingerer (Schacter, 1986a). On the other hand, a successful malingerer reaps highly salient positive reinforcement in a civil proceeding in the form of monetary compensation and negative reinforcement in a criminal proceeding in the form of a more desirable disposition.

Memory is a private event and the assessment of its functional integrity is not always a straightforward process. Given the importance of accurately and efficiently evaluating neuropsychological function and dysfunction in a forensic context, the mental health professional is poorly equipped to discriminate effortful and motivational aspects of a patient's performance (Brandt, 1988). This state of affairs is readily apparent in the experimental literature involving malingered amnesia. Taken as a group, the experimental studies attempting to discriminate between malingered and genuine amnesia have produced mixed results and are quite difficult to implement in the clinical or medicolegal setting (Brandt, 1988; Schacter, 1986a, 1986b; Wiggins & Brandt, 1988).

Brandt and his colleagues (Brandt, 1988; Rubinsky & Brandt, 1986) state that the lay public's perception of normal memory functioning is that it can be easily faked and that such faking is difficult to detect, in part because of the belief that it would be easier to withhold behavior (i.e., produce a behavioral deficit) than it would be to demonstrate a positive symptom. Most researchers feel that a malingerer will be successful in producing believable deficits to the

extent that he has detailed knowledge about the syndrome he is attempting to simulate and has a refined ability to simultaneously monitor and regulate his performance throughout a long and anxiety provoking testing situation (see Binder & Pankratz, 1987, and Goebel, 1983, for more detailed reviews).

It is the aim of this study to examine the performance of normal subjects given the instructions to malinger memory dysfunction on various clinical and experimental memory tests, including two perceptual indirect memory tasks (word stem completion and perceptual identification). These indices may be sensitive to a malingering response style for several reasons. First, it is unlikely, even given the recent flurry of academic activity, that a lay person's knowledge of amnesia would include the knowledge of the dissociation of explicit and implicit processes. Additionally, the nature of the implicit memory indices (e.g., instructions that disguise the memory component; perceptual identification occurring at or near absolute threshold) may make them somewhat resistant to volitional control. First, the various theoretical issues related to malingering will be reviewed. Bona-fide impairment secondary to brain damage will then be covered. Next, an in-depth review of the literature involving the experimental portrayal of "mental deficiency," "brain damage," and "amnesia" will be offered. Implicit memory will be dealt with next. The Introduction section of this paper will conclude with a statement of the proposed problem and experimental hypotheses to be tested.

Malingering

Any psychological assessment technique which derives its information from a person's verbal behavior may be affected by a deceptive response style. The term "dissimulation" refers to the deliberate distortion or misrepresentation of symptoms (Rogers, 1988). This category subsumes such concepts as "defensiveness," "random responding," and "irrelevant responding." This paper is concerned with another type of dissimulation, malingering. Malingering is defined by the American Psychiatric Association (APA, 1987) as "the intentional production of false or grossly exaggerated physical or psychological symptoms, motivated by external incentives such as avoiding military conscription or duty, avoiding work, obtaining drugs, or securing better living conditions" (p. 360). The implicit assumption of this definition is that malingerers are socially deviant individuals (i.e., those with antisocial personalities) who are likely to fabricate illness when involved in the legal system and are likely to demonstrate poor compliance with assessment and treatment procedures (Rogers, 1990a). As Rogers (1990a) correctly states, the DSM-III-R, in its attempt to remain atheoretical about etiology, nevertheless conceptualizes malingering from a moralistic and criminological perspective. These issues will be dealt with in depth in later sections.

Brief History

The concepts and behaviors underlying malingering have been recognized throughout history (Bash & Alpert, 1980) and have been recorded

as early as biblical times (Jones & Llewellyn, 1917, cited in Bash & Alpert, 1980). In military populations, an increase in the prevalence of malingering can be directly linked to times of war (Anderson, Trethowan, & Kenna, 1959). Excluding wartime, the emergence of malingering as a diagnostic and legal entity largely resulted from the Industrial Revolution (Miller & Cartlidge, 1974). Regler (1879, cited in Miller & Cartlidge, 1974) documented the increased frequency of malingering as the result of the first accident insurance laws in Prussia. As technology has progressed, industrial machinery has become more complex, resulting in more dangerous working conditions and a higher frequency of both legitimate and malingered injury. Mental health professionals, including psychologists and neuropsychologists, are testifying as expert medicolegal witnesses with increasing frequency (Lees-Haley, 1984).

Differential Diagnosis

The concepts of intentionality and goal-orientation are central to the definition of malingering (Cunnien, 1988) and form the basis for differential diagnosis. Before making the diagnosis of malingering, the clinician must rule out genuine impairment, factitious disorder, and somatoform disorder. Factitious disorders are characterized by the "intentional production or feigning of psychological [or physical] symptoms" due to a "psychological need to assume the sick role, as evidenced by the absence of external incentives for the behavior, such as economic gain, better care, or physical well-being." This disorder must not occur exclusively during the time course of an Axis I mental

disorder, such as bipolar disorder (manic phase) (APA, 1987, p. 318). Thus, the malingerer and the patient with factitious disorder both voluntarily respond deceptively, with the former being voluntarily motivated to dissimulate by the prospect of external secondary gain, while the latter reflects an involuntarily adopted psychological goal to assume the role of sickly patient (Drob & Berger, 1987).

Somatoform disorders refer to a group of psychiatric disorders in which there are "physical symptoms suggesting physical disorder for which there are no demonstrable organic findings or known physiologic mechanisms, and for which there is positive evidence, or a strong presumption, that the symptoms are linked to psychological factors or conflicts" (APA, 1987, p. 255). Conversion disorder is subsumed by this category. In somatoform disorders the mechanisms linking mind and body are presumably not under conscious control (Reich & Gottfried, 1983). Therefore, a malingerer and an individual with somatoform disorder both demonstrate physical symptoms that have no known etiologically significant physical cause, with the former intentionally dissimulating for an obvious environmental goal, and the latter unintentionally altering his presentation and no obvious environmental goal.

Classification

One of the most difficult clinical aspects associated with malingering is classification (Bash & Alpert, 1980). The diagnostic task is made all the more difficult for the clinician due to the high costs to the medical system from an

unrecognized malingerer, as well as the high costs to the patient incorrectly labeled as a malingerer (Pankratz & Erickson, 1990; Wasyliw & Cavanaugh, 1989). Although debated in the literature, malingering is essentially an act, performed in specific situations for the purpose of obtaining positive or negative reinforcement, which exists apart from the actual mental status of the patient (but see Menninger, 1963 for a discussion of the minority opinion that malingering is a mental illness). However, malingering can certainly coexist with mental illness (APA, 1987) and personality disorder (Clark, 1988). The distinction between an act and a mental status is endorsed by several sources. First, the American Psychiatric Association (APA, 1987) classifies malingering as a "V Code," i.e., "a condition not attributable to a mental disorder that is a focus of treatment" (p. 359). Second, Gorman (1982) states that an act is differentiated from status in both statute and case law, in the sense that landmark decisions have established that it is constitutional to punish a person for performing a wrongful act (e.g., for consuming illegal drugs) but not for his or her mental status (e.g., for being intoxicated on illegal drugs).

Recent empirical and theoretical work (Rogers, 1987, 1988) has suggested that the traditional view of malingering as a dichotomous construct (presence versus absence) is not consistent with clinical observations. Rather, Rogers states that malingering may in fact be a continuous construct reflecting gradations of dissimulation. Several authors have advanced classification schemes for malingering which take this issue into account. Schroeder (1966)

divided malingering behavior into four subtypes: (1) pure invention of symptoms; (2) perseveration, in which formerly genuine, bona-fide symptoms continue; (3) exaggeration, in which genuine symptoms are presented as worse than they actually are; and (4) "transference," in which genuine, bona-fide symptoms are attributed to an erroneous cause.

Travin and Potter (1984) have suggested three nondiscrete and overlapping demarcation points on the malingering continuum: (1) other-deceivers who correspond to the DSM-III-R notion of a fully aware and fully volitional malingerer; (2) a midrange category of mixed-deceivers, in which the patient is aware that he making up some aspect of the present symptom but is not aware that other aspects of the symptom are beyond his control; and (3) an end-range category of self-deceivers, in which the subject more completely deceives himself in not realizing the origin of the presented symptoms.

The Development of Malingering

The American Psychiatric Association, faced with a divergence of thought on the purposes of diagnosis and the underlying theory of psychopathology, based DSM-III and DSM-III-R on atheoretical classification schemes (Rogers, 1990a). Rogers has offered several reviews of the prominent models of malingering (1990a, 1990b). The pathogenic model of primarily dynamically oriented analysts (Menninger, 1935; Eissler, 1986) views malingering as an ineffective defense mechanism which attempts to control psychotic and neurotic processes by voluntary acceptance and conscious reproduction of the

underlying psychopathology. In this view, malingering is an attempt to cope with underlying psychological and emotional conflicts by accepting and controlling their expression. While primary mental illness and malingering are not mutually exclusive, Rogers (1990a) asserts that the pathogenic model offers little explanatory power for either etiology or motivation.

The DSM-III-R model, discussed previously, can be criticized on several points (Rogers, 1990a). The emphasis on background and contextual aspects of the patient's history tends to shift the clinician's focus away from aspects of the clinical presentation of the suspected malingerer. Specifically, Rogers states that there is insufficient evidence to support the alleged association of malingering with antisocial personality disorder. Uncooperativeness with assessment and treatment procedures is felt to be characteristic of a number of other bona-fide mental disorders and thus not specific to malingering. The term "discrepancies with objective findings" is unnecessarily ambiguous. As several researchers have pointed out, corroborative and naturalistic observational data rather than "objective data" may prove more useful in the assessment of a patient's actual impairment (Rogers, 1990a; Rogers & Cunnien, 1986; Pankratz & Erickson, 1990). For example, informal conversation with the suspected malingerer after the "evaluation" may reveal detailed and intact memory for the route taken to the hospital, even though the patient demonstrates severe impairment on memory tests (Drob & Berger, 1987).

The adaptational model shows considerable promise as a conceptual framework for understanding malingering. This model views malingering as goal-seeking behavior designed to maximize the chances of success on the basis of expected utility and likelihood (Rogers, 1990a). This model completely avoids the overly pathological (malingerers as "mad") and criminological/moralistic (malingerers as "bad") thinking associated with the other conceptual models. Rather, malingering behavior is dealt with in terms of its adaptive value; malingerers are pursuing a course of action that seems to him or her to be the most effective way of adapting to the difficulties life poses and of eliciting needed support from others (Pankratz & Erickson, 1990). Most clinicians would certainly label malingering as "maladaptive" and, to some extent, "incorrect" (Pankratz & Erickson, 1990; Binder, 1990).

The true value of the adaptational model is that it properly focuses the clinician on treating the patient, a task which often goes overlooked in the struggle to accurately diagnose the suspected malingering patient. Viewing behavior as maladaptive rather than criminalistic also helps the clinician avoid negative countertransferential reactions to the patient (Rabinowitz, Mark, Modai, & Margalit, 1990). Pankratz and Erickson (1990) feel that treatment should be offered to the suspected malingering patient as it would any other; namely, collaborating with the patient to determine whether psychological treatment could potentially make the patient's life more fulfilling and satisfying.

Memory Impairment Following Brain Damage

Amnesia

Amnesia refers to a condition characterized by the impairment of normal memory functioning in which a person has an acquired difficulty in learning new material and in recalling remote events. Amnesia can be classified according to etiology (organic versus psychogenic) and chronicity (discrete episodes versus persistent impairment) (Kopelman, 1987). As it is most frequently used, amnesia refers to a neurological condition that can result from a variety of etiologic agents and loci of lesions (Butters & Miliotis, 1985). Anoxia, encephalitis, electroconvulsive therapy (ECT), cerebrovascular accidents, closed head injuries, and surgical damage have all produced amnesia in patients (Drachman & Arbit, 1966; Milner, 1970; Squire, Chace, & Slater, 1976; Levin, Benton, & Grossman, 1982). Lesions to the medial diencephalic structures, including the dorsomedial nucleus of the thalamus and the mammillary bodies (Victor, Adams & Collins, 1971; Butters & Cermak, 1980), the fornix (Heilman & Sypert, 1977), and the retrosplenial area (e.g., splenium, retrosplenial cortex, and cingulate bundle) (Valenstein, Bowers, Verfaellie, Heilman, Day & Watson, 1987) have all produced amnesia.

However, amnesia can have a psychogenic etiology as well (Kopelman, 1987). This phenomenon, which has also been referred to as functional amnesia (Schacter, 1986a), refers to amnesia for a discrete episode of time occurring in the past. It is produced by severe psychological and emotional

trauma. The condition has been well documented and mimics the retrograde amnesic aspects of organic amnesia (Abeles & Schilder, 1935; Schacter, Wang, Tulving, & Friedman, 1982). Amnesia secondary to fugue states (Berrington, Liddel & Foulds, 1956) and the act of committing a violent crime (see Hopwood & Snell, 1933) are two examples of temporally discrete amnesias.

Amnesia presents a clinical picture manifesting four distinct characteristics (Butters & Miliotis, 1985). All amnesics have anterograde amnesia, or impairment in the ability to learn new information. Second, all amnesics have some degree of retrograde amnesia (impairment in retrieving information learned prior to illness onset). Attentional capacity is spared in "pure" cases. The above mentioned deficits exist in the presence of intact intellectual and other higher cortical functions.

Closed Head Injury

An adequate understanding of malingering in the neuropsychological context warrants a careful review of the literature involving the etiology and nature of memory impairment following closed head injury (CHI), a condition frequently associated with malingering (Binder, 1990). Impaired memory functioning is one of the most frequently cited neurobehavioral sequelae of closed head injury (Brooks, 1972; Levin, Benton, & Grossman, 1982; Schacter & Crovitz, 1977). Neurotic symptoms are the most common psychiatric symptoms associated with closed head injury (Lishman, 1973; Miller, 1961) and include the so-called "accident neurosis" (Miller, 1961), reactive depression in

response to a variety of mental and functional losses, and emotional aspects of postconcussion syndrome (PCS) (Lishman, 1973). While PCS encompasses many common medical symptoms, it also commonly involves impairment in attention, concentration, and memory processes. The critical issue for this paper is the fact that the etiology of PCS remains a highly controversial issue, with no clear agreement as to the relative etiological contributions of organic damage, psychiatric and personality factors, compensation, and litigation (Binder, 1986). Many investigators have suggested that medicolegal and related factors may play a significant role in maintaining psychiatric disorder and memory impairment (Miller, 1961; Levin, Benton, & Grossman, 1982).

Epidemiology

The magnitude of the problem presented by traumatic brain injury to modern society is immense (Lishman, 1973). In 1967 three quarters of a million people sustained a traumatic brain injury in the United States. Of these, 18,000 died, 13,000 sustained permanent disability, and 7,000 sustained temporary disabilities. In a large sample of severely injured patients, Jennett and colleagues (Jennett, Snoek, Bond, & Brooks, 1981) found that slightly over half of their 314 patients remained moderately and severely disabled after six months. Significant morbidity is associated with even mild injuries (Rimel, Giordani, Barth, Boll, & Jane, 1981; Binder, 1986).

Neuropathology of closed head injury

The brain experiences many pathophysiological changes during a closed head injury. Important determinants of these effects are the direction of the blow, its force and velocity, and whether the head was free to move at impact (Nilsson and Ponten, 1977; Lishman, 1973). Regardless of the nature of the injury, the traumatically injured brain is subject to manifold rotational and linear stresses which tear and damage nerve fibers (Lishman, 1973). These changes have been noted after even mild head injury (Strich, 1969). Cortical lesions are maximal in portions of the frontal and temporal poles (Sekino, Nakamura, Yuki, Satoh, Kikuchi, & Sanada, 1981). White matter damage is often found in subcortical tracts, the corpus callosum, and the long tracts of the brain stem (Lishman, 1987). Adams and colleagues (Adams, Mitchell, Graham, & Doyle, 1977) have noted that these changes occur immediately after injury and play an important role in mortality. Concussion and loss of consciousness are more likely to result from injuries in which the brain is free to move at impact, producing rotational and shearing forces. Damage to brain stem centers is usually necessary to produce concussion and loss of consciousness. In addition to structural damage which occurs following closed head injury, changes have also been noted in the biochemistry and cerebrovascular circulation (Lishman, 1973).

Memory and learning after PTA termination

Immediate memory. Immediate or short-term memory (STM) refers to the limited capacity system that holds a limited amount of information over brief periods of time (less than one minute) (Watkins, 1974). Immediate memory is usually assessed with the digit span task of the WAIS-R (Wechsler, 1981) or the Wechsler Memory Scale (Wechsler, 1945).

Immediate memory as reflected by forward digit span is comparatively resistant to the effects of CHI (Brooks, 1976; Lezak, 1979; Levin, Benton, & Grossman, 1982). Mildly injured patients generally suffer no reduction in length of forward digit span, even when tested early after admission (Cronholm & Jonsson, 1957; Fodor, 1972). Immediate memory as reflected by the more difficult backward digit span appears more susceptible to the effects of CHI (Levin, Benton, & Grossman, 1982). Brooks (1976) found the forward digit span of patients with severe CHI comparable to that of controls, while backward digit span was significantly impaired relative to controls.

Schacter and Crovitz (1977) state that the findings of normal to near normal digit span in CHI patients may not provide an adequate test of STM processes as measured by more demanding tasks. Brooks (1975) used several experimental methods to investigate STM. He found the short-term memory abilities of CHI patients lower but not significantly different from those of controls. Levin, Grossman, and Kelly (1976) have suggested that the format of information may determine whether deficits are observed in CHI patients.

These investigators found CHI patients to have significant difficulty with short-term recognition of nonverbal designs, even when tested at long intervals after injury.

To summarize, forward digit span appears relatively insensitive to the effects of severe CHI, even when tested soon after injury. Backward digit span, requiring additional information-processing demands, has been shown to be reduced in the early stages of recovery, but to improve over time. More difficult tasks, such as varying the format of to-be-remembered information, may provide a more sensitive index of STM capacities in these patients.

Recent memory. Impaired recent memory functioning (anterograde amnesia) is one of the most prevalent cognitive impairments following closed head injury (Brooks, 1972; Levin, Benton, & Grossman, 1982) and is the primary complaint of most patients and their families (Bond, 1986). Estimates of the prevalence of persistent memory problems after PTA termination have varied, from 16% (Lidvall, Linderoth, & Norlin, 1974) to 23% (Russell & Smith, 1961) to 36% in Russell's (1932) original sample, depending upon the various methodologies used in the studies (Schacter & Crovitz, 1977).

Brooks (1972) investigated the extent of memory deficit in a group of 27 patients who had sustained severe closed head injury. The author found that the CHI patients performed significantly lower than normal controls on all tests measuring learning and recent memory. These differences were statistically significant for all indices except the WMS Visual Reproduction subtest

(immediate recall). Using the WMS and the Rey Figure, Brooks found that CHI patients acquired significantly less information initially and they also forgot proportionately more of this initially acquired information than did controls. Duration of posttraumatic amnesia had a positive and significant relationship to immediate memory and forgetting variables.

Brooks (1974) investigated visual recognition memory in a sample of 34 severely head-injured patients using a continuous recognition paradigm. The results indicated that the CHI patients recognized significantly fewer items, showed slower learning rates over trials, and committed a significantly higher proportion of false negative errors than control subjects. Time elapsed between the injury and the date of testing showed no obvious relationship to memory performance. Severity of injury, as estimated by duration of PTA, correlated with the number of correct recognitions and false positives. False negative errors occurred more frequently in the CHI patients regardless of the severity of the injury, suggesting some kind of threshold effect in that cerebral trauma produces an all-or-none alteration in the CHI memory abilities. Brooks interpreted these findings as evidence that the CHI patients adopted a very strict decision criteria whereby they were unwilling to identify an item as old in the face of uncertainty.

Brooks (1975) employed a list learning task to assess short- and long-term memory in a heterogeneous sample of CHI patients. When tested immediately after presentation, CHI subjects performed similarly to controls for

all serial list positions. However, a 20-second interpolated delay interval between presentation and recall selectively impaired recall in the CHI group. Brooks then categorized recall words as either STM or LTM, based on Tulving and Colotla's (1970) criteria. The results indicated that CHI patients scored lower but not significantly different from controls for STM items. However, the CHI patients scored significantly lower than did controls for LTM items. Brooks interpreted his findings as evidence for impaired LTM storage in CHI patients, with relative sparing of STM processes. Schacter and Crovitz (1977) have been highly critical of this interpretation, citing methodological flaws in the experimental memory tasks employed in this study.

Brooks (1976) investigated Wechsler Memory Scale performance in a sample of 82 severely head-injured patients. With the exception of Mental Control subtest errors and Digits Forward, CHI patients were inferior to controls on all other WMS subtests. On Logical Memory, CHI patients were significantly poorer at an immediate and delayed recall, although their rate of forgetting was not significantly greater than controls'. CHI patients were significantly lower on Associate Learning and their rate of learning across trials was lower. In general, CHI patients demonstrated proportionately more impairment on delayed memory tasks. Neither focal neurological signs, the presence and site of skull fracture, nor the elapsed time since injury had appreciable effects on memory performance. The finding concerning elapsed time since injury is

interpreted by Brooks to reflect an early recovery of memory, often in the first few months after injury, to a permanently deteriorated level.

Lezak (1979) tracked the course of recovery of verbal memory functions over time in a sample of 24 CHI patients. Estimates of severity of injury were omitted from her paper. Patients were serially tested at three different points of recovery. Dependent measures included digit span tests (forward and backward) and selected variables derived from the Rey Auditory Verbal Learning Test (RAVLT). The results indicated that on simple measures of immediate memory, Digits Forward and the first recall trial of the RAVLT, CHI patients were only mildly impaired at the initial testing and showed consistent improvement over time. More complex measures of learning were more significantly impaired and remained so over time. On every measure, the more severely impaired patients performed more poorly at initial testing than less severely injured patients. The less severely injured subjects generally maintained their superiority over more severely injured patients at all three points of recovery. One interesting finding is that a subset of the CHI patients showed a deterioration of performance on the complex memory tests at the final point of testing (three years post injury), suggesting a possible multifactorial recovery mechanism. Lezak suggested that partial recovery from a severe injury may occur relatively early on while other pathophysiological processes may compromise memory efficiency in the later stages of recovery.

Gronwall and Wrightson (1981) investigated memory and information processing capacity following closed head injury in a heterogeneous sample of 91 patients. Using a variety of cognitive tasks, including the Wechsler Memory Scale, the Selective Reminding Test, and the Paced Auditory Serial Addition Task, these investigators isolated three relatively independent cognitive impairments associated with CHI. Simple and undemanding memory tasks appear resistant to impairments in information processing capacity, while memory tasks which involve complex processing demands and time constraints appear susceptible to this impairment. The ability to store information in LTM was deficient in CHI patients. This ability was found to be related to either severity of injury or elapsed time since injury. One quarter of the sample demonstrated an additional deficit in the ability to retrieve material from LTM once it has been stored. This impairment bore no relationship between severity of injury or severity of information processing deficit.

Levin and Goldstein (1986) investigated whether long-term survivors of severe CHI could gain access to semantic stores and spontaneously use clustering strategies to guide encoding and retrieval during a list learning task. The results indicated that controls remembered significantly more words than CHI patients when tested with free and cued recall paradigms. Both groups recalled more words when the stimuli were semantically clustered during learning. Whereas control subjects tended to spontaneously impose their own clustering to guide encoding and retrieval, CHI patients generally failed to

spontaneously use these strategies. Patients with frontotemporal involvement tended to produce a higher number of intrusion errors. Decreased verbal intellectual functioning was found to be closely related to impaired verbal memory functioning. The authors concluded that survivors of severe CHI have partially preserved semantic memory, although their failure to actively engage in meta-mnemonic strategies may contribute to reduced memory efficiency.

Crosson and his colleagues (Crosson, Novack, Trenerry, & Craig, 1988) employed the California Verbal Learning Test (CVLT) to further investigate qualitative aspects of memory impairment following head injury. The sample included 33 survivors of severe head injury along with 33 neurologically normal adult male control subjects. The control group performed at a significantly higher level than the CHI group on all five individual learning trials. Qualitative aspects of performance were equated for overall performance level. When overall level of performance was taken into account, both groups showed equivalent incremental learning across trials as well as number of perseverations. CHI patients consistently demonstrated a greater percentage of intrusions in their response output and a lower level of spontaneous use of semantic clustering. CHI patients lost a significantly greater amount of information over delay intervals, as evidenced by impairment on both recall and recognition probes. The authors interpreted their data as evidence for disruption in multiple memory processes in survivors of severe CHI, including problems with encoding, retention, and retrieval of information.

Summary. The literature reviewed provides overwhelming evidence for memory impairment following CHI. While survivors of CHI perform normally on simple memory tasks, impairment is noted on more complex memory and learning tasks requiring active and effortful processing of to-be-remembered information. These patients acquire information at a slower rate than do normals. They evidence greater forgetting of information after acquisition, resulting in more marked impairment on delayed memory tests.

The effects of compensation and litigation

Postconcussion syndrome (PCS) refers to a constellation of common symptoms which include headache, dizziness, irritability, anxiety, blurred vision, insomnia, easy fatigability, and concentration and memory difficulty (Levin, Benton, & Grossman, 1982; Lishman, 1973). While PCS as a diagnostic entity is generally accepted, its etiology remains a hotly contested issue, especially when symptoms persist for long periods (Binder, 1986). Miller (1961) argued that PCS is entirely the result of the litigation process. Levin, Benton, and Grossman (1982) call into question new symptoms that appear after an initial hospitalization and suggest that the etiology of such symptoms probably is not organic.

After reviewing the literature concerning the effects of litigation and compensation on PCS, Binder (1986) concluded that it is not possible to draw firm conclusions in this area because of a lack of objective evidence. Specifically, some studies have shown a correlation between claims and

disability or persisting subjective symptomatology (Miller, 1961; Cartlidge, 1978). However, this relationship is not causal; it seems reasonable to assume that a patient with prolonged symptoms after compensable trauma would be more likely to make a claim than a patient who recovers quickly (Binder, 1986). Conversely, research has also shown that prolonged symptoms can persist in patients with mild head injury who are not seeking compensation (Rimel, Giordani, Barth, Boll, & Jane, 1981). Binder concludes that the literature does not support the contention that patients become less symptomatic after a legal claim is settled.

The point to be made here is that the issue of persisting subjective symptoms and complaints, in the absence of definitive neuropathological findings, essentially fulfills one of the DSM-III-R criteria for diagnosing malingering (Binder, 1990). It is in these cases where there is "discrepancy between the person's claimed stress or disability and the objective findings" (APA, 1987, p.360) that malingering becomes a viable yet precarious differential diagnosis.

Experimental Studies of Malingering

The foregoing discussion emphasizes the importance of thoroughly evaluating neuropsychological symptomatology in cases of suspected malingering. Only a few cases have been reported in the literature in which the patient suspected of malingering either relinquished his symptoms in favor of genuine responding (Pankratz, 1979) or admitted to having faked impairment

(Hartings, 1989). Therefore, clinicians are rarely certain of the true nature of impairment in cases of questionable motivation. This gives rise to the need for experimental analog studies which attempt to mimic the clinical situation by instructing subjects to portray or "simulate" impairment on testing.

Malingered Mental Deficiency

Pollaczek (1952) investigated the ability of normal college males and normal Navy recruits to feign feeblemindedness on the "CVS" abbreviated intelligence scale, a measure which consists of the Comprehension and Similarities subtests from the Wechsler-Bellevue test and selected vocabulary items from the Stanford-Binet Intelligence test (Hunt, French, Klebanoff, Mensh, & Williams, 1948). Fifty male mental retardates were used as the criterion comparison group. The results indicated that malingering subjects demonstrated mental impairment equivalent to that of true mental defectives. Thus, malingerers could not be detected with the use of the CVS total raw score. An item-by-item analysis revealed significant between-groups differences on 17 of 37 test items. These critical items were of two types: (1) relatively easy items occurring at the beginning of each subtest which mental defectives complete accurately while malingerers failed; and (2) relatively difficult items occurring at the end of each subtest which mental defectives fail but which malingerers passed. Cut-off scores were derived and a linear discriminant function classification produced an 87% sensitivity rate for malingering subjects, with a 10% false positive rate.

Spreen and Benton (1963) instructed subjects to portray the performance of a "high grade mental defective." Their sample consisted of three groups composed of genuine mental defectives, medical inpatient simulators, and normal simulators who were evaluated with Form "C" of the Visual Retention Test (VRT) (Benton, 1955). The two simulating groups showed no differences in performance and were subsequently combined into one group. These investigators found simulators to perform significantly below mental defectives on measures indicative of overall level of performance (i.e., number of correct reproductions and number of circumscribed errors) and to produce significantly more bizarre or improbable responses than actual mental defectives. This study has several methodological flaws, however. First, a normal control group was not employed. Second, and more serious, Spreen and Benton preexperimentally equated their two simulating groups by their performances on Form "A" of the VRT. This allowed the simulators to be exposed to the task in which they would later feign and thus confounded the results with the effects of preexisting knowledge and practice.

Gudjonsson & Shackleton (1986) looked at the effects of "faking-bad" on the pattern of scores on the Raven's Matrices test. Subjects included normals recruited from military settings and a criterion comparison group of 25 neurological patients with bona-fide mental impairment. Several statistical methods were employed to assess consistency across tests of differing complexity. The results indicated that malingering subjects failed too many of

the easy items at the beginning of the test, resulting in a relatively stable rate of performance decay as test complexity increased. This pattern of performance was not characteristic of subjects performing their best or of patients with bona-fide neurological impairment. Subjects in these conditions scored higher on the easy portions of the test, resulting in a normal rate of performance decay as testing complexity increased.

Malingered "Brain Damage"

Anderson, Trewothan, and Kenna (1959) instructed a group of normal subjects to portray "mental abnormality for some reason best known to themselves." Various aspects of their behavior were then compared with groups of patients with documented organic brain damage, pseudodementia patients (as best can be determined, a mixed group of patients suffering from mental deficiencies associated with depression and other psychopathology), and a control group of normal volunteers. Analysis of their data revealed that the malingering group's level of performance tended to fall between the levels of the normal group in the unimpaired range and the organic and pseudodementia group in the impaired range on measures of orientation, verbal retention and recall, digit span, concentration, mental arithmetic, and general knowledge. Thus, simulators apparently did not overplay their role. In the qualitative domain, simulators produced significantly fewer perseverations than did the organic group.

Bruhn and Reed (1975) instructed normal college subjects to simulate brain damage secondary to concussion and then compared their performance on the Bender-Gestalt Test with a nonsimulating normal group and a group of patients with mixed cortical trauma. In their pilot study, Bruhn and Reed found that both the Pascal-Suttell and Canter scoring methods did poorly in discriminating organics from simulators. However, a diplomate sorted malingerers from organics and organics from normals with hit rates of 89% and 92%, respectively. In their main study, two expert raters and one novice used decision rules derived from the pilot study to obtain similarly accurate discriminations among the three groups. Thus, nonbrain-damaged subjects were not successful at malingering brain damage on the Bender-Gestalt test.

Heaton, Smith, Lehman, and Vogt (1978) instructed normal subjects to "fake the most severe [neuropsychological and psychological] disabilities they could, without making it obvious to the examiner that they were faking" (p. 894). Their design included a group of head-injured patients with documented residual neurologic deficits and a group of normal volunteers given instructions to malinger. The outcome measures consisted of the WAIS, the Minnesota Multiphasic Personality Inventory (MMPI), and the Halstead-Reitan Neuropsychological Test Battery. Their results indicated that the malingerers exhibited an overall level of performance similar to head-injured patients in that no group differences were observed on summary measures (three WAIS intelligence quotients and HRNB impairment indices). Qualitative differences

emerged when profile analysis was undertaken. Malingering subjects significantly underestimated deficits when completing the Category Test, the Trail Making Test (Part B error component), and all components of the Tactual Performance Test while they significantly overestimated deficits when completing the Speech-Sounds Perception Test, the Finger Oscillation Test, finger agnosia and sensory suppression tasks, grip strength, and digit span. MMPI profiles of the malingerers revealed clinical elevations on the F scale and 6 clinical scales (1, 3, 6, 7, 8, 0). Therefore, malingering subjects performed poorly on motor and sensory tasks and produced questionably valid MMPI profiles, but they performed relatively well on tests sensitive to brain damage. Heaton et al. (1978) then submitted the test protocols to ten expert judges for classification. In general, the accuracy of the judges ranged from chance-level to approximately 20% better than chance. Since the raters were given only test scores, the poor classification rates may be attributable to the absence of clinically relevant data, such as interview protocols and behavioral observations. Finally, results from multivariate discriminant function analyses indicated that neuropsychological variables accurately predicted group membership in that 100% of the subjects in both malingering and head-injured groups were correctly classified. Heaton et al. (1978) concluded by stating that the observed group differences were sufficiently reliable to predict membership in head injury and malingered head-trauma groups and that MMPI variables may have improved discriminatory power.

Mensch and Woods (1986) examined whether groups of subjects with normal and above average IQ scores could appear "brain damaged" on the Luria-Nebraska Neuropsychological Battery if motivated by a small monetary reward conditional on successful feigning. They employed a double-blind crossover design. Analysis of their data indicated that 31 of 32 subjects were able to significantly elevate enough individual scales to suggest brain damage. However, the malingering subjects' profile of test scores was not qualitatively consistent with profiles of patients with known neurological pathology. For example, malingering subjects did not demonstrate significant differences between the Left and Right hemisphere scales. Malingering subjects consistently performed quite poorly on sensory motor tests and tests whose face validity was high and displayed exaggerated response latencies. Mensch and Woods concluded that the subjects instructed to malinger brain damage in their study were unsuccessful.

Goebel (1983) investigated the issue of whether naive, neurologically normal subjects could feign believable deficits on the HRNB, as well as the more specific question of whether lateralized deficits were more difficult to simulate than diffuse or nonspecific deficits. Goebel's design consisted of six groups: mixed neurologic patients, control subjects, and patients told to simulate either "nonspecific," "diffuse," "left hemisphere," or "right hemisphere" cortical damage. In a sort of the test protocols, only 2 of 102 malingering subjects were incorrectly classified (i.e., feigned believable deficits).

Goebel implied, but did not provide supporting data, that several variables (Impairment Index, Category Test, Trails B, and TPT Localization score) appeared to provide good discriminatory power. Linear discriminant function analyses revealed that Speech Sounds, TPT Nondominant hand, and time-to-complete testing were powerful variables in discriminating neurologic patients from nonpatients. Brain-damaged patients took approximately 1.5 hours longer to complete testing than did non-brain damaged subjects. Grip Strength Nondominant hand, Finger Tapping Nondominant hand, and WAIS Performance IQ were powerful variables in discriminating normal controls from malingering subjects. Goebel also presented data from the debriefing interview which suggested that individuals were relatively ignorant of brain-behavior relationships. The most frequently employed strategies of feigning brain damage included giving wrong answers, slowing of performance, and displaying motor incoordination.

Hayward, Hall, Hunt, and Zubrick (1987) asked 28 registered nurses with varying degrees of experience in working with neurological and neurosurgical patients to simulate performance on a battery of neuropsychological tests in such a way as to be congruent with a history of trauma to the left frontotemporal cortex. These data were compared with data obtained from 21 patients with documented cerebral injury and a diagnosis of left frontotemporal dysfunction. A linear discriminant function analysis resulted in a sensitivity rate of 86% for both malingering subjects and patients with bona-fide impairment.

Specificity rates were 14% for each group. Malingering patients generally produced lower scores than patients with bona-fide impairment. Malingerers performed poorly on tests not expected to be affected by left frontotemporal involvement. Qualitatively, malingering performance was characterized by elaboration and confabulation (i.e., commission of incorrect behavior), as opposed to the poverty of content characteristic of the brain-damaged patients. Malingerers produced types of errors on sensory tests which are not typical of bona-fide impairment (e.g., confusing digits 1 and 4 on the finger localization test, instead of the more typical confusion of 2 and 3).

Faust, Hart, & Guilmette (1988) investigated whether a relatively broad sample of clinicians could identify the malingered protocols of nonsophisticated subjects. Three children between the ages of 9 and 12 were instructed to "fake bad" on the HRNB. All three subjects produced impaired performances on this battery of tests. Information regarding age, sex, handedness, test scores, and qualitative data from the Aphasia Screening Test was given along with test data to a random sample of practicing neuropsychologists. Judges rated the results on normal versus abnormal, etiology, severity of impairment, and confidence in their diagnosis. The detection rate for malingering was 0%. Moreover, clinicians rated themselves as moderately to highly confident in their diagnoses.

This study was altered slightly and replicated using adolescent subjects to produce malingered HRNB profiles (Faust, Hart, Guilmette, & Arkes, 1988). In Study 1, most clinicians (78%) who received no forewarning of the possibility

of malingering classified the cases as neuropsychologically abnormal; 0% of malingering profiles were detected. In Study 2, clinicians were forewarned about the malingering protocols and given the base rates. However, their overall classification accuracy did not surpass chance levels.

Faust and his colleagues (Faust, Hart, & Guilmette, 1988; Faust, Hart, Guilmette, & Arkes, 1988) have confidently concluded from these two studies that "adults and adolescents can convincingly portray neuropsychological deficits." (Faust, Hart, Guilmette, & Arkes, 1988, p. 513). Bigler (1990) has rightfully taken extreme issue with these methodologically-flawed studies. In general, the Faust et al. (1988) study fails to approach the reality of clinical practice. Specifically, the use of questionnaires containing only raw test scores, the paucity of historical and interview information, and over-reliance on "objective" indicators biased the results towards the over-interpretation of "pathology" and provided insufficient information to make accurate clinical decisions. The true competency and qualifications of the respondent judges could also be challenged.

Malingered Amnesia

Benton and Spreen (1961) compared brain damaged patients with neurologically normal subjects instructed to portray moderate memory, concentration, and motivational deficits secondary to an automobile accident. They found that the simulators overplayed their role in that they performed at a level significantly below that of brain damaged patients. Qualitatively, simulating

subjects tended to produce very few omission, perseveration, and size errors, opting instead to produce many more distortion errors than are often seen in genuinely brain damaged populations.

Williamsen, Johnson, and Eriksen (1965) instructed a group of subjects to feign hypnosis and post-hypnotic amnesia. The instructions given to this group were nonspecific and provided no didactic information about posthypnotic amnesia. No incentive was offered for successful malingering. This group was compared with groups of nonsimulating/hypnotized subjects and genuine/nonhypnotized subjects on free recall, word fragment completion, "word association", and two-alternative, yes/no recognition measures. The results obtained indicated that the malingering subjects' level of performance was significantly lower than the posthypnotic amnesics on all measures. A critical finding was that the simulators abnormally suppressed their responding on several measures of implicit memory.

In a brief report, Brandt, Rubinsky, and Lassen (1985) administered a 20 item word list to groups of normals, normals simulating amnesia, patients with Huntington's disease, and patients with unspecified head trauma. These subjects were tested first with free recall and then with two-alternative, forced choice recognition paradigm (cf. Pankratz, 1983). No information was reported concerning the instructions used for the malingering group, nor was there any apparent external incentive to malinger. Brandt and his colleagues found that the malingering group performed the most poorly on free recall, though not

significantly different from the other patient groups. The malingering group produced recognition memory performance that was not above chance levels; three of the ten had recognition scores below chance.

Schacter (1986) created a laboratory analogue of an episodic event in order to examine various meta-mnemonic variables in groups of normal subjects and subjects instructed to "simulate forgetting" of this episode. The episodes consisted of a passage from a novel and videotaped events and was constructed in such a way that virtually no subject would be able to accurately recall it. The instructions given to the simulating group were quite brief and emphasized the believability of their performance. No reward was offered for successful simulation. The dependent variables in this study included "feeling of knowing" ratings, which refer to a person's belief that he could retrieve or recognize an unrecalled item, event, or fact if he were given more powerful hints or cues (c.f., Schacter, 1983). In Experiment 1, Schacter found that simulators, relative to the genuine condition, demonstrated significantly lower cued recall performance and scored significantly below chance on a two-alternative, forced choice recognition test. Transcripts of each subject's verbalizations at the time of recollection were provided to six expert judges, who were subsequently unable to correctly sort the two groups. Finally, simulating subjects were significantly more pessimistic that retrieval cues and multiple choices would improve their remembering of the episode.

Experiment 2 replicated and extended these results to show that simulators displayed the same pattern of inaccurate meta-memorial ratings after a 90 minute delay period, while Experiment 3 replicated the results after a 24 hour delay period. Expert raters in both Experiments 2 and 3 were still unable to discriminate between genuine and simulating subjects.

There are several aspects which may limit the generalizability of this study to situations outside of the laboratory. Most importantly, this experiment had subjects simulate the forgetting of a specific, temporally-limited episode. While this situation has direct relevance to certain criminal cases (eg., in the form of a defendant claiming amnesia at the time of a crime), it neglects the situation seen in many civil actions in which an individual claims a defect in his memory process which impairs his ability to learn new information. Additionally, the simulating subjects may never have initially learned the information under question, and thus, may never have "forgotten" the information (Wiggins & Brandt, 1988).

Wiggins and Brandt (1988) used both explicit and implicit memory measures in their attempt to discriminate experimental malingerers. In Experiment 1, five groups were evaluated. Three groups of malingerers (one instructed to simulate amnesia resulting from head injury; one instructed to simulate amnesia resulting from psychological trauma; and one instructed to simulate amnesia of an unspecified etiology) were compared with a group of true amnesics (n=4) and a group of nonsimulating controls. No suggestion

was given to the simulators concerning the severity of their feigned amnesia nor were the simulators offered an incentive or reward for successful malingering.

In Experiment 1, the malingers' performance was characterized by (1) extremely poor performance on overlearned, autobiographical information (worse than the performance of even the most impaired patients); (2) performance on free recall lower than normals but greater than amnesics; (3) a normal serial position effect, and (4) essentially normal priming effects on measures of implicit memory. The simulators demonstrated essentially normal priming effects on an immediate test. However, when retested after a 24 hour delay the simulators produced significantly fewer target words than the other groups, thus slightly suppressing their word stem completion performance. On a word association task, simulators did not differ significantly from normals and amnesics, with all three groups exhibiting slight priming effects. Of note is the fact that virtually no differences were detected between the three subgroups of malingerers, prompting the conclusion that lay people are not generally aware of symptomatic differences between various types of amnesia.

In Experiment 2, Wiggins and Brandt administered two, 20-item lists of concrete nouns to the same groups described above, and elicited free recall and recognition using a two-alternative, forced-choice recognition test (c.f. Pankratz, 1983). The amnesic group recalled fewer words than the malingerers, who recalled fewer words than the normal controls. The malingerers replicated a normal serial position curve. Twenty one percent of

the malingerers performed at chance levels on yes/no recognition, though no malingering subject performed below chance. This performance was significantly below the recognition levels displayed by the amnesics and normal controls. The authors concluded that simulators portray amnesia, regardless of its etiology, as characterized by recall performance better than, and recognition performance worse than, that of true amnesics, and that the malingerer' serial position curve resembled that of normals rather than that of amnesics.

Boone (1989) directly examined the effect of coaching on malingering subjects' neuropsychological memory test performance. Boone randomly assigned 87 subjects, volunteering for course credit, to one of three conditions: uninformed-faking, informed-faking, and normal control. The subjects were instructed to simulate the performance of a person who has recently sustained a "mild to moderate" head injury in an automobile accident. A five dollar reward was offered for "successful malingering", although in actuality all subjects received this payment. Boone hypothesized that the performance of malingerers would be characterized by significant levels of intratest and intertest inconsistency, as operationally defined as significant deviations from the mean scores on a scale, significant discrepancies between similar scales, improbable temporal patterning of responses, and improbable performances relative to the binomial distribution.

The results demonstrated that the performance of the groups of malingerers was significantly more inconsistent than the control group, with the

uninformed-faking group performing more inconsistently than the informed-faking group. A large proportion of malingerers performed in the severely impaired range, with uninformed-fakers again demonstrating more significant levels of impairment than informed-fakers. This study replicated previous findings that malingerers generally tend to overplay their roles. Two significant stepwise discriminant function analyses reliably sorted the three groups with an accuracy rate of 91%. This study would have benefitted from the inclusion of a group of head injury patients.

Mittenberg, D'Attilio, Gage, and Bass (1990) administered a 30 item symptom checklist to two large groups of subjects who were instructed to malinger "symptoms" secondary to a closed head injury they supposedly sustained six months ago. One group of subjects reported having pre-experimental knowledge about the symptoms of closed head injury while the contrast group reported having no special knowledge. No objective criteria of the subject's knowledge of brain-behavior relationships was used verify group membership. In both groups, postconcussion syndrome was malingered significantly more than memory symptoms. Memory complaints were faked at a level not significantly different than chance. However, post-concussion syndrome was malingered by 80% of the subjects.

Wylie and Ruff (1990) instructed subjects in post-concussional syndrome. Multivariate and clinical detection procedures were used to contrast groups of matched controls, litigating head injury patients, and nonlitigating head injury

patients with multivariate and clinical detection procedures. Their results indicated that clinical and blind raters failed to accurately discriminate malingerers from other subjects, although multivariate analyses of variance detected significant group differences between normals and other groups. Multivariate discriminant function analyses improved classification of malingerers and head injury patients by 20% over chance.

Bernard (1990) investigated the vulnerability of several widely-used neuropsychological memory tests to experimental malingering. Three groups of subjects were used: malingering with no financial incentive, malingering with financial incentive to the two subjects who produced the most believable deficits, and normal controls performing genuinely. Overall, there were few differences between malingerers in the incentive and nonincentive conditions, whereas both groups of malingerers performed more poorly than the controls. Two stepwise discriminant function analyses were performed on reduced variable sets. The first variable set, which included WMS-R Figural Memory and Immediate Visual Reproduction, produced accuracy rates of 74% on cross-validation. The second variable set, which included ROCF Delayed Reproduction, RAVLT Trial 1, and RAVLT Recognition, produced accuracy rates of 77% on cross-validation. While this study incorporated many methodological improvements, the failure to employ a group of subjects with bona-fide memory impairment as the criterion of successful malingering no doubt limits the generalizability of these results (cf., Schretlen, 1988).

Bernard (1991), in a later article, further analyzed the performance of this same sample of subjects on the Rey Auditory Learning Test. The inclusion of a group of 18 CHI subjects with relatively severe injuries who were tested early in their recovery improved the methodology of the study. The results indicated that the malingering group scored significantly lower than the control group, but scored significantly higher than the CHI group. Thus, the malingerers portrayed deficits of insufficient magnitude to resemble patients with bona-fide memory impairment secondary to severe CHI. Further inspection of the data revealed that malingering subjects obtained low scores by suppressing their recall of words from the primacy portion of the list.

Iverson, Franzen, & McCracken (1991) used a verbal list-learning paradigm to investigate the performance of experimental malingerers, patients with bona-fide memory impairment of mixed etiology, and normal controls performing to the best of their ability. Two procedures, free recall of stimuli and two-item, forced recognition, were employed. The mean free recall score for the normals was significantly greater than those for malingerers and memory-disordered patients; the latter two groups did not differ significantly. Main effects of group on serial position for recall and recognition were nonsignificant. In the forced-choice task both normals and memory-disordered patients outperformed malingerers. Sixty percent of malingering subjects scored significantly below chance levels, while the remaining 40% scored within the confidence interval constructed around chance performance. No malingering

subject scored better than chance. Comparisons with other studies employing this paradigm should not be made due to the restricted number of trials employed here (21) as compared with the standard of 100.

Specific Clinical Techniques to Detect Malingerers

Symptom validity testing

Original paradigm. Theodor and Mandelcorn (1973) first reported the use of a two-alternative, forced-choice paradigm for evaluating the validity of a claim of disability or impairment. This procedure is quite simple in nature. The subject is presented with one of two distinct stimuli and is then, after a brief delay, asked to determine which of the two had been presented. This is repeated until a sufficient number of trials have been administered, usually at least 100 trials. The subject's performance is then compared with what would be considered chance performance. Nominal chance performance is 50% correct. A performance significantly different than chance is interpreted as the subject having a preserved ability to perceive and discriminate between the two stimuli. If the subject's performance is significantly below chance, then the subject is suspected of feigning the deficit. For 100 trials, 41% accuracy is associated with the cumulative binomial probability of 0.04. Alternatively, the subject is making accurate discriminations if his performance is significantly above chance. An essentially "normal" subject is expected to score at or near 100% correct. This procedure has been termed "Symptom Validity Testing" (SVT) by Pankratz, Fausti, and Peed (1975). Symptom Validity Testing can be

altered by making the stimuli more complex and giving the subject the impression that the task is very difficult (c.f., Lezak, 1983).

Theodor and Mandelcorn (1973) used this technique in a case involving "hysterical blindness." Their patient did in fact demonstrate significantly below-chance discrimination of a visual stimulus, suggesting that the patient was processing the stimulus and then volitionally refusing to report it. Pankratz, Fausti, and Peed (1975) successfully employed the SVT paradigm to demonstrate that a patient claiming loss of hearing was in fact discriminating the stimulus on some level. Pankratz (1983) and Binder and Pankratz (1987) extended these findings, demonstrating the utility of Symptom Validity Testing to the detection of feigned memory impairment. Binder has reported five additional case studies in which a below-chance performance on forced-choice testing was helpful in making the diagnosis of malingering (Binder, 1990b, 1992). Pankratz (1979) demonstrated that Symptom Validity Testing, when presented to the patient with an expectation for change, allowed the patient to spontaneously relinquish his symptoms while still maintaining his dignity and the belief in the physical basis for the symptoms.

Modifications to original paradigm. Following Pankratz's advice (1988), clinicians have begun to modify and adapt forced-choice testing to meet their individual clinical needs. Three methods have recently appeared in the literature. Hiscock and Hiscock (1989) varied the objective task difficulty by introducing varying retention intervals into the paradigm. Five digit numbers

were printed on index cards and presented to subjects to study for five seconds. Response cards were printed with the target digit string along with a foil, also a five digit number. Response trials were grouped into three blocks of 24 trials. Presentation of the response card was delayed five seconds in the first block of 24 trials, ten seconds in the second block, and 15 seconds in the final block. No intervening distractor activity occurred between presentation of the study and test cards. Prior to the first block of trials, the patient was told that the task constituted a "memory test." Following the first and second blocks, the patient was told that he had performed well and that, consequently, the retention interval would be increased to make the task more difficult in the next block of trials. This procedure created the illusion of difficulty for the suspected malinger. In actuality, correct answers could be produced by simply recalling the first of the five digits.

Three subjects were then tested with this procedure: a patient suspected of malingering, a severely demented patient, and a normal five year-old girl. The results indicated that although the suspected malingerer scored exactly at the chance level for the first block of trials, his scores showed a progressive decline across the second and third blocks. His overall accuracy rate of 29% fell significantly below chance ($z=-3.54$, $p<.0002$). The normal child's score of 82% was significantly above chance. Perhaps most important, the demented patient obtained a score of 51% accuracy, which was not significantly different from chance. This finding correctly highlights the need to determine the

component cognitive processes involved in this task, as well as to validate the procedure on various neuropsychological patient groups.

Binder's Portland Digit Recognition Test (Binder, 1990b; Binder & Willis, 1991) is similar to that of Hiscock and Hiscock (1989) with two exceptions. Binder incorporates retention intervals of five, 15, and 30 seconds into the three blocks of 24 trials. In addition, the interval between study and test is interpolated by having the subject count backwards. These authors reported data from testing a series of 64 patients with well-documented brain dysfunction of varying etiologies who were judged to be motivationally-intact. The mean performance of these patients was approximately 75% correct; the worst performance was 54% correct.

Bickart, Meyer, & Connell (1991) devised the Malingered Memory Deficit Test, a 50-trial test of feigned short-term recognition memory. The basic task requires subjects to view a sequence of consonants, consisting of a pair of letters in random sequence (e.g., RTRRT). After a five second latency period, the subject is shown a second stimulus identical to the first with the exception of a missing element (e.g., RTR_T). The subject is required to supply the name of the missing letter, selecting one of two presented alternatives. Four alternatives were devised to assess the difficulty, by varying the number of elements the subject was required to remember (either three or five letters) and the effects of interpolated counting. Subjects were 114 male prison inmates who were instructed to "take the tests as you think a person with severe

memory problems would" (p.11). Below-chance performance levels were observed in only 18.8% of the subjects in the Difficult/Interpolation condition, 21% of the subjects in the Difficult/No Interpolation, 21.5% of the subjects in the Easy/Interpolation condition, and 19.2% of the subjects in the Easy/No Interpolation condition. Above-chance performance levels were observed in 49.5% of the subjects in the Difficult/Interpolation condition, 49.5% of the subjects in the Difficult/No Interpolation, 54.8% of the subjects in the Easy/Interpolation condition, and 55.8% of the subjects in the Easy/No Interpolation condition.

Summary of SVT research. In general, the two-item forced-choice testing paradigm appears to be a highly useful tool to include in a forensic neuropsychological assessment. This utility may be based on several concepts. The malingerer probably does not realize his performance should be no worse than chance. This may result from simple ignorance of the laws of probability or the malingerer's subjective feeling that producing incorrect responses on only half the trials underestimates the seriousness of his problem. Even if the malingerer does recognize the probabilistic nature of the task, it is difficult to keep track of his responses and to maintain a consistent pattern of choices. With enough trials, even small errors in judgement would render a score improbable (Binder & Pankratz, 1987). However, malingering subjects may be suspicious of transparently simple tasks, and may choose not to feign impairment on those tasks (Bickart et al., 1991).

Rey's techniques

Fifteen-item test. Lezak (1983) describes several of the French neuropsychologist Andre Rey's clinical techniques designed to assess dissimulation. In the Memorization of 15 Items technique (Fifteen Items Test, FIT), the patient is presented with a three by five item array of symbols, and he is asked to memorize the "difficult" stimuli. In actuality, only three or four concepts are needed for accurate recall. According to Lezak, only the most significantly impaired individuals recall less than three of the five character sets.

Several empirical studies of the FIT have been published recently. Goldberg & Miller (1986) administered the FIT to psychiatric inpatients and mentally deficient patients. Their results confirmed the criteria proposed by Lezak (1983) and suggested that malingering should be considered among individuals who deny remembering at least six of the 15 items. Bernard and Fowler (1990) administered the FIT to brain-damaged patients and normal controls. Their results generally supported the cutoff of nine correct items. A comparison of the number of sets of items which were correctly recalled was nonsignificant.

Morgan (1991) validated the FIT on a sample of 60 patients with bona-fide mild to severe memory impairment. The cutoff of 9 correct items was again confirmed. However, "failure" on the FIT resulted from bona-fide, severe memory impairment in some subjects. Qualitative analysis of the protocols failed to reveal consistent indicators of bona-fide memory impairment. Lee,

Loring, and Martin (1992) provided additional validation data for the FIT administered to temporal-lobe epileptics and consecutive outpatient neuropsychology clinic referrals. These authors suggested a more conservative cutoff of seven correct items. In addition, litigating outpatient referrals scored significantly lower than nonlitigating outpatient referrals.

Dot-counting task. A second task employs seven 3 by 5 inch index cards upon which dots are placed in an organized (grouped) or random (ungrouped) manner. The patient is instructed to count the dots as quickly as he can, his reaction time for each card is noted, and these times are compared with normative data from normal adults as well as head injury patients. The patient's performance for this task is evaluated in terms of the difference between the reaction times for the grouped and ungrouped dots. Deviations from the logical temporal pattern may lead the clinician to doubt the patient's motivation.

Recognition memory paradigm. Finally, a third task involves administration of a 15-item word list. Recognition memory is tested immediately. Later in the session, the subject's level of recognition is compared with the first trial of free recall on a list learning test (e.g., Rey Auditory Verbal Learning Test). Given the well established fact that recognition generally exceeds free recall, a deviation from this pattern suggests a nongenuine response style.

Summary. All three of Rey's tasks attempt to capitalize on the potential malingerer's lack of requisite knowledge about brain-behavior relationships and on his inability to simulate behavior that is foreign to him while monitoring the effectiveness of this behavior in the testing situation. Morgan (1991) cautions against the use of any of these techniques in isolation.

Summary and Critique of Experimental Studies of Malingering

The performance of normal subjects instructed to malinger neuropsychological dysfunction has been shown to vary widely from study to study. On indices of quantitative performance, some studies have found malingerers to appear significantly more impaired than the organic populations they are portraying (Benton & Spreen, 1961; Hayward et al., 1987; and Iverson et al., 1991; Schacter, 1986; and Spreen & Benton, 1963) while other studies have found malingerers to appear more impaired than normals but less impaired than organic patients (Anderson et al., 1959; Bernard, 1991; Brandt et al., 1985; and Wiggins & Brandt, 1988). Other studies have found malingerers to exhibit similar levels of impairment as organic patients (Heaton, Smith, Lehman & Vogt, 1978; and Mensch & Woods, 1983). Many studies have found malingerers to perform qualitatively differently than either normals or organic patients (Benton & Spreen, 1961; Boone, 1989; Goebel, 1983; Heaton, Smith, Lehman & Vogt, 1978; Spreen & Benton, 1963; and Wiggins & Brandt, 1988). At this point, a call must go out for a more standardized methodology. The nature of instructional set, the amount of didactic information provided to

malingering subjects (i.e, "coaching"), and the saliency of incentive to produce believable deficits vary widely from study to study.

An informal meta-analysis was conducted on the studies involving experimental malingering Table 1 presents this data. This sample of studies is neither random or representative. Studies were included in the meta-analysis if they presented means and standard deviations on the outcome measures. A study had to have directly compared the performance of subjects instructed to malinger dysfunction with either normals performing their best (control group) or neuropsychological patients with bona-fide impairment (criterion group). In general, studies were excluded if they failed to present means and standard deviations.

The results of the meta-analysis corroborate the conclusions drawn from the qualitative review of the literature. First, an average effect size of -3.5 is attributed to "treating" subjects with instructions to malinger. Following Smith & Glass' (1974) interpretative framework, this effect size means that a subject scoring at the mean of the control group would fall to 3.5 standard deviations below the mean of the control group when given instructions to malinger. This is an exceptionally large effect size which may be the result of floor and ceiling effects associated with some dependent measures. For example, Mensch & Woods (1986) employed the LNNB scales as outcome measures which defined normality very close to zero, resulting in both mean scores near zero and artificially constricted variance. On the other hand, normal subjects often obtain

Table 1
Effect Sizes from Selected Experimental Studies of Malingering

Study	Malingerers vs. Normals	Bonafide Impairment vs. Normals	Malingerers vs. Bonafide Impairment
Pollaczek (1952)			-0.1
Heaton et al. (1978)			+0.1
Brandt et al. (1985)	-2.7	-1.7	
Gudjonsson & Shackleton (1986)	-0.8		
Mensch & Woods (1986)	-8.8		
Hayward et al. (1987)			-1.5
Wiggins & Brandt (1988)	-1.9	+0.3	
Boone (1989)	-5.2		
Bernard (1990)	-1.9		
Bernard (1991)	-1.7	-3.2	+1.0
Iverson et al. (1991)	-5.2	-2.0	-1.9
Average Effect Sizes	-3.5	-1.7	-0.5

near perfect scores on other outcome measures, such as recognition paradigms, resulting in very high mean scores and artificially constricted variance. Nevertheless, the effect size computed is no doubt significant and fulfills Cohen's (1977) criteria for a "large" effect size.

Second, an effect size of -1.7 is attributed to bona-fide organic impairment. That is, a subject scoring at the mean of the control group would fall to approximately 1.7 standard deviations below the mean of the control group if he were to sustain organic impairment. The true litmus test is applied when malingerers are compared with the criterion group representing bona-fide impairment or deficiency. An average effect size of -0.5 is associated with the comparison between organic patients and malingering subjects, which prompts the conclusion that malingerers are able to successfully suppress the quantitative level of their performance to levels associated with organic impairment.

Given that malingering subjects fall to 3.5 standard deviations below the mean of normals and subjects with bona-fide impairment only fall to 1.7 standard deviations below the mean of normals, it would seem at first glance that malingering subjects should score approximately 1.8 standard deviations below organic patients instead of the observed effect size of -0.5. Upon further inspection, however, it becomes clear that these values cannot be validly compared because the referent comparison group (i.e., the group whose standard deviation represents the denominator of the effect size equation) is

not the same. The magnitude of the effect size created by the lower means of malingering subjects is greatly attenuated by the inherent variability of the bona-fide impairment group. While not mathematically correct, it appears plausible that malingering groups score significantly lower than organic groups in terms of normal control group standard deviations, a situation analogous to the clinical situation of comparing a subject's performance to normal subjects, rather than organically-impaired patients.

Analysis of the qualitative nature of malingerers performance bears out Rubinsky and Brandt's (1986) hypothesis that the malingerer is more likely to alter his performance by withholding behavior (i.e., producing a behavioral deficit) such as not recalling a word, rather than producing additional behaviors (i.e, producing a positive symptom) such as perseveratively recalling a word. A likely explanation for this tendency rests on the malingerer's ignorance of brain-behavior relationships or on the general idea that "less" is "worse" when it comes to expressions of cognitive ability. Given this ignorance, it may be that "comission" of behavior is too risky a strategy.

Multivariate discriminant function analyses have been used to attempt to discriminate malingerers from normals from organic patients with some measure of success. However, these classification equations have yet to be cross-validated in independent, clinical samples, and are of uncertain value in the individual case. Highly variable sensitivity and specificity rates have been produced by clinicians evaluating and sorting test protocols of these three

groups. This approach has limited generalizability to the clinical setting due to the scarcity of qualitative (e.g., verbatim test protocols and interview transcripts) and observational data that has typically been provided to the clinical judges.

Several indices have emerged which appear promising. Symptom Validity Testing has been shown to be robust in clinical case studies of relatively blatant and unsophisticated malingering. Between-groups designs have begun to validate SVT and Rey's FIT with other neuropsychological patient groups as well as fine-tune the basic paradigms along task difficulty and retention interval dimensions. Two studies (Williamsen, Johnson & Eriksen, 1965; and Wiggins & Brandt, 1988) have provided initial evidence that malingering subjects may tend to suppress their responses to supraliminal implicit memory indices (word stem completion and word association). This suppression of priming appears to intensify after the malingering subject "catches on" to the memorial nature of the tasks.

Implicit Memory

Modern experimental research involving implicit memory phenomena includes different areas of concentration (Schacter, 1987). Implicit memory can be demonstrated with paradigms involving savings during relearning (c.f., Slamecka, 1985), the effects of subliminally encoded stimuli (c.f., Cheesman & Merikle, 1986), and learning and conditioning without awareness (c.f., Greenspoon, 1955). However, these three areas of research are outside the focus of this paper and will not be reviewed. The present paper will concern

itself with the phenomena of repetition priming (c.f., Cofer, 1967), which refers to the facilitative effects of a learning episode on performance of a subsequent task, such as word stem completion or tachistoscope identification (Graf & Schacter, 1985).

Definitions

Richardson-Klavehn and Bjork (1988) contrast implicit and explicit forms of memory with direct and indirect measures of memory. Forms of memory are definitionally hypothetical and require an assumption to be made concerning the subject's mental content or mental state at the time of testing. Explicit memory is commonly assumed to involve the deliberate, directed retrieval of information about specific episodes. Explicit memory is demonstrated when performance on a task requires conscious recollection of a previous experience. Implicit memory does not depend on directed, conscious demonstrations of memory when performance on a memory task is facilitated or somehow altered in the absence of conscious recollection (Graf & Schacter, 1985).

Measures of memory can be categorized with respect to task instructions and measurement criteria (Johnson & Hasher, 1987). This nomenclature avoids excessive assumptions concerning mental states and processes involved in performing tasks. Explicit memory is commonly tested by direct measures of memory such as free recall, cued recall, and recognition. Implicit memory is tested with indirect memory tasks in which the measures of

interest reflect a change (typically a facilitation) in task performance observed by comparing performance with relevant prior experience to performance without such experience (a control condition). The term indirect is particularly suitable because the relevant tasks do not direct the subject to a target event (Richardson-Klavehn & Bjork, 1988).

Theories of Implicit Memory

Two main classes of theories of implicit memory currently occupy the attention of researchers: multiple memory systems models and processing models (Roediger, 1990). Experimental manipulations have been shown to differentially affect direct and indirect memory tests with both normal subjects and amnesic patients (Shimamura, 1986; Schacter, 1987). Therefore, the task of any theoretical model is to account for the numerous dissociations between these forms and measures of memory (Richardson-Klavehn & Bjork, 1988).

Researchers postulating distinct and separate memory systems derive support from experimental studies of amnesic patients. The central concept is that certain forms of brain damage selectively affect the memory system for conscious recollection but leave the system responsible for other forms of learning relatively intact. Squire and Cohen (Cohen, 1984; Cohen & Squire, 1980; Squire, 1987) have advanced a taxonomy consisting of functionally separate memory stores for declarative and nondeclarative (formerly "procedural") memory. Declarative memory (i.e., "knowing that") is available to consciousness and can be accessed by processes congruent with the

contextual and temporal information it contains. Nondeclarative memory (i.e., "knowing how") is not directly available to consciousness and is only capable of being accessed by engaging in processes in which it is embedded. Thus, amnesia is conceptualized as a preservation of procedural memory as indexed by indirect memory tasks and a failure of declarative memory as indexed by direct memory tasks. Much of the experimental evidence for dissociations between direct and indirect tests can be interpreted within this framework because the memory systems are though to be largely separate (Roediger, 1990).

Other researchers, primarily cognitive psychologists working with normal subjects, have proposed various processing models to account for the data. Processing models de-emphasize the possibilities of different memory stores and the dissociation of encoding, storage, and retrieval. Instead, Jacoby (Jacoby, 1983a, 1983b, 1984) as well as Roediger and his colleagues (Roediger & Blaxton, 1987b; Roediger, Weldon, & Challis, 1989) postulate that implicit and explicit memory differ in terms of the relationships between processes operating at both encoding and retrieval. Jacoby (1983b) delineates two dissociable processes operating on a single, episodic memory store. Processing of semantic information requires the initiation of conceptually-driven processes by the subject. Such processes include elaboration, organization, and rehearsal. Certain tasks that emphasize perceptual or orthographic information invoke data-driven processing. These researchers feel that implicit memory as

measured by indirect tests is primarily indexing data-driven processes and explicit memory as measured by direct tests is primarily indexing conceptually-driven processes. It should be emphasized that these concepts represent two end-points on a single continuum rather than discrete categories.

Roediger (1988) spells out the assumptions which follow from the processing model. First, performance on memory tests should be facilitated to the extent that the cognitive operations at test recapitulate those engaged during the study episode. Second, direct and indirect tests typically, but not always, require different retrieval operations and consequently benefit from different types of processing during learning. Most direct memory tests draw on the encoded meaning of concepts or on semantic or elaborative processing. Conversely, most indirect tests rely heavily on the match between perceptual operations between study and test.

The Relationship between Explicit and Implicit Memory

The central concept that this study will attempt to use to "catch" malingering subjects is the idea that intentional, explicit retrieval (or suppression of retrieval) can affect performance during nominally indirect memory tests. In order to fully understand the circumstances under which this can occur, a discussion concerning the relationship between implicit and explicit forms of memory is necessary. Three areas of research speak to this issue. First, some studies have demonstrated stochastic independence between implicit and explicit memory tasks and have used this data to argue that under some

circumstances intentional retrieval does not contribute to repetition priming (Tulving, Schacter, & Stark, 1982). Second, studies testing implicit memory after degraded encoding demonstrate that implicit memory can occur in the absence of explicit memory (Eich, 1984). Third, as levels of processing manipulations have been shown to robustly affect direct memory tests, LOP manipulations may increase the likelihood that explicit retrieval may intrude during indirect memory tests (Schacter, 1987). This review will lay the groundwork for a careful review of the work of Bowers and Schacter (1990) which directly investigated implicit memory, LOP, and test awareness.

Stochastic independence

The concept of stochastic (statistical) independence between direct and indirect memory tests has been taken as evidence for a dissociation between implicit and explicit forms of memory (Tulving, Schacter, & Stark, 1982). Stochastic independence is the name given to the relation between two events in which the probability of their joint occurrence is equal to the product of the probabilities of the occurrence of each event alone (Tulving, 1985). In a typical experiment, a subject completes an indirect test of memory, such as word stem completion. He then completes a yes/no recognition memory test for the study words. Two scores are then computed. The simple probability of word stem completion refers to the proportion of study words which were correctly completed in their target direction. The simple probability of recognition memory refers to the proportion of target words which were correctly

recognized on a direct recognition test, irrespective of word stem completion status. The conditionalized probability of recognition memory refers to the proportion of correctly generated target words that were later correctly recognized on a direct recognition test.

Therefore, stochastic independence exists when the conditionalized probability of correct recognition does not exceed the product of the two simple probabilities. Unlike functional independence, stochastic independence is not based on comparing the average performance on two tests, but rather on determining whether performance on a particular item on one test predicts performance on that same item on another test. If no predictive relationship is found, then the tests are assumed to be independent (Witherspoon & Moscovich, 1989).

In the present context, the concept of stochastic independence becomes relevant because it allows the researcher to examine the relative contribution of explicit memory processes on indirect memory tests. In general, a number of studies have firmly demonstrated stochastic independence between direct and indirect memory tests (Richardson-Klavehn & Bjork, 1988). Jacoby and Witherspoon (1982) biased the homophone spelling for amnesic patients and normal control subjects. The spelling of homophones required in the second phase of the experiment provided an indirect measure of the effect of the prior presentation of the homophone on its later interpretation. Both groups of subjects demonstrated intact implicit memory for the biased spelling. Yes/no

explicit recognition for the biased spellings was intact for normals and severely impaired for the amnesic patients. More importantly, the conditionalized probability of recognition did not differ significantly from the simple probability of correct recognition for either group. This procedure was repeated using perceptual identification as the indirect memory test. The results were equivalent; the two tasks were found to be stochastically independent across 12 conditions that differed in overall rate of identification.

Tulving et al. (1982) found that probability of recognition conditionalized on successful word fragment completion was equivalent to the overall proportion of words recognized for four conditions that differed in overall recognition probability. Tulving (1985) reported the extensive results of Chandler's (1983) work which manipulated the relationship between fragment completion and direct memory tests in 32 separate conditions. Without exception, stochastic independence was found in that recognition conditionalized on correct fragment completion was essentially equivalent to simple recognition.

Several studies, however, have found stochastic dependence between performance on an indirect and a direct memory test. Jacoby and Witherspoon (1982) presented a long list of pronounceable pseudowords for study. A test of recognition memory for the studied pseudowords was presented in the second phase of the experiment. A perceptual identification test, given in the final phase of the experiment, included "new" pseudowords as well as words that

had been studied and presented in the test of recognition memory. In line with previous results, the prior presentation of a pseudoword was found to be sufficient to enhance its subsequent perceptual identification. Recognition memory for the pseudowords was also found to be accurate. In contrast to results obtained for words, however, performance on the two types of test were dependent on one another. Pseudowords that were later perceptually identified were more likely to be recognized as having been presented during study (.80) than were pseudowords that were not later perceptually identified (.70). In addition, G. Hayman (unpublished observations cited in Schacter, 1985b) found stochastic dependence in an experiment in which subjects were instructed to use word fragments to help retrieve study-list words. Several authors have argued that this data can be explained by assuming that subjects used explicit memory in both the direct and indirect tests (Richardson-Klavehn & Bjork, 1988; Schacter, 1985b).

Criticism has been aimed at this procedure on practical as well as theoretical grounds. Shimamura (1985) argued that stochastic independence may be an artifact produced by the influence of the first test on the second test. Performance on the stem completion task represents an additional study trial for items successfully completed. Therefore, it appears to be a plausible assumption that the exposures and subject reactions that comprise performance on the indirect test do not leave the memory system unaltered and ready to give an uncontaminated picture of the influence of the study episode

on a second test (Richardson-Klavehn & Bjork, 1988; Tulving et al., 1982). Given these two lines of evidence, the methodology offered by stochastic independence may be one way to evaluate implicit-explicit relationships in the context of manipulations of motivation and retrieval intentionality.

Restricted or degraded encoding

Studies involving restricted or degraded encoding of stimuli are indirectly relevant to the present issues of motivation and retrieval intentionality because they offer the opportunity to observe normal performance on indirect memory tests with accompanying low levels of performance on direct memory tests (Bowers & Schacter, 1990). Eich (1984) used a speech-shadowing paradigm to present target words (homophones) for unattended study. Spelling was used as an indirect memory test and yes/no recognition served as the direct memory test. Priming was observed under these degraded study conditions, even though explicit memory for the words was extremely low. Eich interpreted his findings as a dissociation between deliberate or intentional remembering and remembering without awareness. Kunst-Wilson & Zajonc (1980) tachistoscopically presented irregular geometric shapes to normal subjects for one millisecond exposure durations. The test phase consisted of an affective discrimination rating followed by a two-item forced choice recognition memory judgement. Priming was observed in these subjects despite chance-levels of recognition memory for the shapes.

The study by Jacoby, Woloshyn, and Kelley (1989) warrants a more detailed review. In Experiment 1, famous and nonfamous names were presented to be read aloud under conditions of divided or full attention. Gains in familiarity of names were tracked by changes in performance on a later fame-judgement task. Explicit memory for the previous presentation of the names was tested with a standard recognition memory test. Gains in familiarity were demonstrated even when studied with divided attention, while explicit recognition memory was lower after divided attention than full attention.

Additional experiments were conducted to preclude the possibility that the familiarity measure actually reflected some instances of conscious recollection. Gains in familiarity were placed in opposition to conscious recollection to further separate the two processes. All names presented in the study phase were nonfamous and the subjects were told so. Subsequent conscious recollection of a name during the fame-judgment task would allow subjects to be certain that the name was nonfamous. Familiarity without conscious recollection would result in the opposite, calling a name "famous". Attention was divided again at study and later during the fame-judgement task. The accurate recognition of old nonfamous names in the full-attention condition allowed those names to be called "famous" less often. In contrast, dividing attention radically reduced list recognition. The failure to recognize old nonfamous names in combination with a gain in their familiarity was revealed by the finding that old nonfamous names were more likely to be called "famous"

than were new nonfamous names in the divided-attention condition. Thus, Jacoby and his colleagues were successful in demonstrating that unconscious memory can operate independently from conscious memory.

The foregoing studies demonstrate that implicit memory for target stimuli can be demonstrated on indirect memory tests in the relative absence of conscious, explicit memory for the same stimuli. This evidence, however, is only of indirect interest because most studies of implicit memory have involved testing normal subjects under unrestricted encoding conditions, making it possible that normals are typically aware of the study episode during the performance of an indirect memory test (Bowers & Schacter, 1990). Additionally, elaborative encoding manipulations would be expected to increase the strength of the memory trace, thereby increasing the likelihood that a subject would experience either awareness of remembering or intentional explicit retrieval (Bowers & Schacter, 1990; Richardson-Klavehn & Bjork, 1988; Schacter, 1987; Squire, Shimamura, & Graf, 1987).

Level and elaboration of encoding

The levels of processing (LOP) framework was conceived as a model of memory which focuses on the processes involved in learning and remembering. It differed from its predecessors in the information-processing tradition which focused on the structural aspects of the cognitive system (i.e., the successive stages through which information flows). The LOP framework proposed to study more directly those processes involved in remembering (e.g., attention,

encoding, rehearsal, and retrieval) and to formulate a description of the memory system in terms of these constituent operations (Craik & Lockhart, 1972; Craik & Tulving, 1975).

A typical LOP manipulation involves incidental learning in a semantic or conceptual study condition (e.g., rating the pleasantness; deciding whether a word fits in a sentence) versus a physical or orthographic study condition (e.g., searching for particular letters in the word) (Craik & Lockhart, 1972; Craik & Tulving, 1975). The relationship between LOP and performance on direct, explicit measures of retrieval has been shown to be quite robust in normal subjects: "deeper" semantic processing produces greater explicit retrieval than does more "shallow" processing (Craik & Tulving, 1975; Bradshaw & Anderson, 1982), which is thought to be due to cognitive elaboration taking place during the encoding process.

Prior to the popularity of the processing model, most researchers agreed that LOP had a null effect on indirect memory tests (Graf & Mandler, 1984; Graf, Mandler, & Haden, 1982; Graf, Squire, & Mandler, 1984; Jacoby & Dallas, 1981; Richardson-Klavehn & Bjork, 1988). However, the processing model has allowed for the categorization of indirect memory tests into primarily conceptual tests versus primarily perceptual tests. Indirect perceptual tests include word fragment completion, word stem completion, and tachistoscopic perceptual identification. Research has established that LOP affects priming in indirect conceptual tests (Hamann, 1990; Srinivas & Roediger, 1990).

Challis and Broadbeck (1992) provide an excellent and authoritative review of research into LOP effects in indirect perceptual tests. Their literature review uncovered a total of 11 published studies which manipulated LOP and measured performance on the indirect perceptual memory tests of perceptual identification (Jacoby & Dallas, 1981; Hashtroudi, Ferguson, Rappold, & Chrosniak, 1988; Light & Singh, 1987), word stem completion (Graf, Mandler, & Haden, 1982; Graf & Mandler, 1984; Graf, Squire, & Mandler, 1984; Squire, Shimamura, & Graf, 1987; Light & Singh, 1987; Chiarello & Hoyer, 1988; Bowers & Schacter, 1990; and Mandler, Hamson, & Dorfman, 1990), and word fragment completion (Squire et al., 1987; Srinivas & Roediger, 1990).

In 33 of 35 separate experiments conducted in these studies, priming was numerically greater in the semantic condition than in the physical condition. While often not statistically significant, the effect sizes of LOP were characterized as small-to-medium magnitude. Challis and Broadbeck (1992) provide illuminating evidence which helps explain these contradictory findings. They found that semantically processed words showed a consistent advantage over orthographically processed words when tested with a word fragment completion paradigm. However, when semantic and physical conditions were presented within-subjects in a mixed list, the LOP effect was negligible and nonsignificant. The authors interpret this finding as evidence for the independent contribution of the physical analysis component of the LOP manipulation.

Issues Related to Awareness and Retrieval Intentionality

The initial section discussing the precise definitions of memory forms and measures highlights a concept which will become central to this study; namely, the issue of explicit memory occurring during indirect tests of memory (Richardson-Klavehn & Bjork, 1988). The concept of conscious recollection is central to the definition of explicit memory. However, Schacter and his colleagues (Schacter, Bowers, & Booker, 1989) argue that "conscious recollection" is an ambiguous term. Conscious recollection can refer to the intentional initiation of retrieval of recently studied information in which the subject deliberately thinks back to a learning episode and searches for target information. On the other hand, conscious recollection can simply refer to awareness of remembering brought on as a consequence of the retrieval process.

Schacter (Schacter, Bowers, & Booker, 1989) discusses five scenarios which illustrate the possible contribution of explicit forms of memory during indirect tests and discusses the methodological difficulty in fractionating forms of memory in experimental studies. Those scenarios which are most relevant to the purposes of this paper are discussed below. In the first case, subjects study words under elaborative study conditions. As instructed, subjects complete each test stem with the first word that comes to mind, and produce a large number of study list items. They do not spontaneously become aware while performing the completion task that any of the items represent a study list

target. But when given a yes/no recognition test that requires them to think back to the study episode, subjects perform quite well, and consciously remember having studied almost all of the words that were produced as completions. This scenario represents normal implicit memory performance in that absence of the spontaneous experience of test awareness, even though the subjects later demonstrate strong explicit memory for the study episode.

The second represents an example of what Schacter (1987) referred to as involuntary explicit memory. Subjects could encode target items under elaborative study conditions, later complete each stem with the first words that comes to mind, and produce a large number of study list items. For some stems, all that comes to mind during completion performance is the target word itself, but for others subjects are reminded by the stem of something that occurred during the study episode. Nevertheless, the subject continues to write down the first word that comes to mind. Thus, a cue involuntarily triggers a recollection of a past event; the awareness of remembering is merely a consequence of the implicit retrieval process.

The third scenario is more clearly a case of voluntary explicit memory. It is identical to the preceding case, except that once subjects notice that one or two of the stems can be completed with the study list items, they surmise that the experimenter is surreptitiously trying to test their memory, and may decide that they can improve their performance by thinking back to the study list and trying to complete each stem with a target item. They have no problem

recollecting most of the words that were presented during the study episode. Thus, the subject "catches on" to the nature of the test and intentionally recollects the prior episode. The subject is essentially engaging in cued recall.

The relevance of LOP effects also becomes clear at this point. Levels of processing effects on indirect memory tests should be apparent to the extent that explicit memory was operating at retrieval. Bowers and Schacter (1990) provide the only direct evidence concerning these issues. These researchers conducted a series of experiments using normal control subjects to determine whether normal priming effects could be observed in subjects who do not experience test awareness during the performance of an indirect memory test, in this case word stem completion. Whereas on-line probes could have been employed, a post-test questionnaire technique was the most direct measure of awareness which avoided inducing awareness. In Experiment 1, study instructions (incidental versus intentional) and test instructions (normal implicit memory instructions versus hints that stems could be completed with target words) were treated as between-subjects factors. Encoding process (semantic versus physical processing) was examined within-subjects in that half of the words were encoded under each encoding condition.

Twenty (50%) of the 40 subjects were categorized as test-aware based on the post-experimental questionnaire. The results indicated that study conditions did not induce test awareness in that 11 of the test-aware subjects were in the study-informed group, and the remaining nine aware subjects were

from the study-uninformed condition. The critical finding was that both aware and unaware subjects showed normal and equivalent priming effects on word stem completion. Thus, normal priming was observed in the absence of test awareness. However, the finding that test-aware subjects completed a statistically significantly higher proportion of semantically encoded words and a relatively low proportion of structurally encoded words suggests that explicit memory did impact WSC performance. No LOP effect was noted for test unaware subjects. Additional evidence of the relationship between test awareness and explicit retrieval was found on subsequent experiments which found that only test-aware subjects demonstrated normal implicit memory for new associations, an indirect test which may be more susceptible to explicit mediation than other indirect tests.

Conclusions

Several lines of evidence have been reviewed which suggest that implicit and explicit memory are functionally independent under certain situations. Implicit memory has been observed when explicit memory was at chance levels due to restricted or degraded encoding conditions (Eich, 1984; Jacoby, Woloshyn, & Kelley, 1989; Kunst-Wilson & Zajonc, 1980). Stochastic independence between performance on direct and indirect memory tests has been observed in several studies (Chandler, 1983; Jacoby & Witherspoon, 1982; Tulving et al., 1982).

However, other studies using designs which leave open the possibility of explicit memory contamination have found stochastic dependence (G. Hayman, unpublished observations cited in Schacter, 1985b; Jacoby & Witherspoon, 1982). Moreover, many theorists consider the issue of explicit memory occurring during performance on a nominally implicit task in need of further research (Richarson-Klavehn & Bjork, 1988; Schacter, 1987; Squire, Shimamura, & Graf, 1987). Bowers and Schacter have presented preliminary data which suggests that normal priming can be observed on word stem completion without the use of explicit retrieval.

The preceding concepts and data concerning awareness and intentionality of retrieval all naturally assume that a subject is honest, is motivated to put forth good effort, and is obeying task instructions by performing in a straightforward manner. The use of an experimental manipulation which varied the motivation of a subject would be expected to influence performance on indirect memory tests to the extent that these tests were vulnerable to intrusion by explicit retrieval processes. Therefore, the use of indirect memory tests is important to the present investigation because it speaks equally to several important clinical and theoretical issues. In the clinical context, indirect memory tests offer the malingering subjects multiple ways to "fail" or produce a level or pattern of performance different from that seen in honest subjects or patients with bona-fide memory impairment. Since the Symptom Validity Testing paradigm has proven quite beneficial to the clinician

due to the indirect nature of its task demands, the indirect memory tests employed by cognitive psychologists may prove useful in the same regard. In a more theoretical sense, the effects of different motivational response sets will extend the domain of knowledge concerning indirect memory tests. Specifically, this manipulation would allow for subjects to spontaneously experience test awareness and/or employ explicit retrieval strategies to either facilitate or suppress their indirect memory performance. The present study could potentially extend the literature by providing a situation in which malingering subjects would be motivated to use explicit memory to lower, rather than raise, their performance on indirect memory tests.

Hypotheses and Predictions

Performance on Clinical Memory Tests

The clinical memory tests will serve two simultaneous functions. First, performance on these tests provides an easily interpretable benchmark upon which to later understand performance on laboratory-based experimental memory tests. Performance profiles can be readily compared with the extant literature to check the validity of the malingering subjects' participation. Second, the performance on clinical memory tests is useful in its own right in that (a) the present battery of tests employed in this study is distinct from others reported in the literature, and (b) it affords a unique opportunity to evaluate qualitative aspects of memory behavior which may provide the clinician with useful interpretive information.

The following specific predictions are made concerning performance on clinical memory tests.

1. Malingering subjects will lower their overall level of performance relative to honest subjects. This simulated impairment will be roughly equivalent to the bona-fide memory impairment produced by closed head injury patients.

2. Malingering subjects will lower their overall level of memory performance to the extent that they adopt response strategies which emphasize the omission of behavior, meaning that these subjects will be unlikely to commit acts of incorrect behavior (i.e., perseverations, distortions, etc.).

3. While succeeding in lowering their quantitative memory performance to levels seen in CHI patients, it is predicted that Malingering subjects will be unable to also mimic the qualitative aspects of bona-fide memory impairment.

4. Analysis of temporal, material, and process-oriented distinctions of memory functioning will demonstrate Malingering subjects to be unsuccessful at accurately portraying memory impairment as it occurs in the CHI patients.

Performance on Indirect Memory Tests

The overriding hypothesis to be evaluated in the present study is that explicit memory does affect performance on indirect memory tests. The likelihood of observing the conflation of explicit and implicit memory on indirect memory tests would appear highest when the words were encoded under elaborative study conditions.

1. Given that explicit memory may affect performance on word stem completion, it is predicted that Malingering subjects will produce abnormally low performance due to postretrieval suppression.

2. Analysis of recognition memory following WSC and analysis of changes in accuracy rate as these subjects proceed through the task will further demonstrate the susceptibility of WSC to postretrieval suppression.

3. De-briefing information concerning test awareness and retrieval intentionality will demonstrate lowered WSC performance in subjects who reported postretrieval suppression.

4. Genuine subjects and Head Injury patients will produce null LOP effects on WSC. Malingering subjects will demonstrate discrepant LOP effects on WSC relative to the comparison groups due to the impact of postretrieval suppression.

5. Malingering subjects will produce normal accuracy rates on a perceptual identification task. However, the extent to which these subjects experience explicit memory for the stimuli and "think about it" before responding will be manifest as increased response latencies.

6. Analysis of recognition memory following PI and analysis of changes in accuracy rate as these subjects proceed through the task will further demonstrate the immunity of PI to postretrieval suppression.

7. De-briefing information concerning test awareness and retrieval intentionality will demonstrate equivalent PI performance in subjects who reported explicitly-mediated suppression.

8. Genuine subjects and Head Injury patients will produce null LOP effects on PI. Malingering subjects will demonstrate similar null LOP effects on PI relative to the comparison groups due to the absence of postretrieval suppression.

Performance on Symptom Validity Testing

As regards Symptom Validity Testing, the main hypothesis to be evaluated is that robust group differences will be observed between the malingering subjects and their comparison groups, in line with the results reported in the literature. The specific predictions are as follows:

1. Malingering subjects will demonstrate significantly lower accuracy rates and significantly higher response latencies than subjects with bona-fide memory impairment.

2. Malingering subjects, taken as a group, will demonstrate a level of performance significantly below that associated with chance performance.

3. Malingering subjects will demonstrate inconsistent responding which can be demonstrated with alternative data analysis techniques.

CHAPTER 2
METHOD

The present study consists of two generally separate experiments. Experiment 1 was conducted using Amnesic patients and matched control subjects. The main purpose of this experiment was to validate the experimental memory stimuli and procedures (word stem completion, perceptual identification, free recall, and multiple choice recognition). In so doing, the quantitative (i.e., strength of priming) and qualitative (i.e., levels of processing effects, dissociations between indirect and direct tests) characteristics of these tasks could be established to provide a well-recognized benchmark upon which to compare the results of Experiment 2. Experiment 2 was conducted using normal college students given two different roles to play (Genuine and Malingering performance), while Head Injured patients were used as the criterion group with bonafide organic memory impairment. By excluding Amnesic patients and their matched controls from the main analyses of Experiment 2, the design was more analogous to that seen in the medicolegal context. Given that malingering is more closely associated with traumatic brain injury (Binder, 1986) than circumscribed organic amnesia, the most important

comparison in this context is that between the suspected malingering patient and the Head Injured patient.

Analysis of Statistical Power

Statistical power refers to the probability of obtaining a significant result (i.e., of rejecting the null hypothesis). A heuristic equation exists which can be computed for a given research design which consists of statistical power, critical effect size, and sample size. By knowing any two of three values, the third value may be determined (Kraemer & Thiemann, 1987).

A power analysis was conducted following the suggestions and dimensions suggested by Kraemer and Thiemann (1987). Effect size estimates were computed from selected experimental studies on malingering and presented in the context of an informal meta-analysis presented in Chapter 1. Several a priori decisions were then necessary. An effect size of (2.0) was taken as a conservative estimate of the effect size associated with the body of literature. The proportion of 0.6/0.4 was taken as representative of the relative number of subjects which could be recruited into the experimental groups and the patient group, respectively. Using Table 4.3 from Kraemer & Thiemann (1987, p. 45) a "critical effect size" was extrapolated to be (0.84). The number of subjects in the malingering and normal healthy control groups was determined from a master table. Therefore, it was determined that 15 to 20 subjects were needed in the each of the Genuine, Malingering, and Head

Injured groups to be 80 percent certain of rejecting the null hypotheses using a one percent, two tailed significance level.

Subjects

Subjects were categorized into five experimental groups. Amnesic patients and age and education matched control subjects participated in Experiment 1. Two types of subjects comprised the three subject groups of Experiment 2. Introductory Psychology students at the University of Florida were randomly assigned to either the Genuine or Malingering groups. Non-litigating Head Injured patients were recruited from several outpatient clinics and an inpatient rehabilitation program located in North Central Florida to serve as the criterion group of bonafide memory impairment.

Amnesic patients were recruited from the standing population of such patients at the Memory Disorders Research Center at the Veterans Affairs Medical Center in Boston, Massachusetts. Data were collected from these patients at the Neuropsychology Laboratory at this hospital. A total of nine Amnesic patients were tested: four with alcoholic Korsakoff's syndrome, three with amnesia due to an episode of anoxia or cerebrovascular accident, one who had a left temporal lobectomy to treat intractable epilepsy, and one who had suffered from encephalitis. The patients with Korsakoff's syndrome consisted of four men (mean age=65.5 years; mean education=11.5 years). The patients with amnesia from other causes consisted of four men and one woman (mean age=46 years; mean education=16.4 years). The mean WAIS-R

Full Scale IQ for these patients was 103 (mean Verbal IQ=100; mean Performance IQ=101). The mean Wechsler Memory Scale-Revised Memory Quotient for these patients was 81 (mean Verbal MQ=70; mean Delayed MQ=57). These subjects averaged 27.5 words recalled on trials 1 to 5 of the California Verbal Learning Test. Neuropsychological evaluation and independent neurological examination indicated that memory impairment was the only remarkable deficit of higher cortical function. These patients have been studied as a group for several years, and their memory impairment has been documented in detail elsewhere (Cermak, Talbot, Chandler, & Wolbarst, 1986).

Control subjects for the Amnesic patients were recruited from various locations throughout the Health Science Center in Gainesville, Florida and were paid twenty dollars for their participation. Subjects serving as control subjects for the alcoholic Korsakoff's patients were recruited from the inpatient Substance Abuse Treatment Program at the Gainesville Veterans Affairs Medical Center. These subjects consisted of four men who were matched to the alcoholic Korsakoff patients on the basis of age and education (mean age=69 years; mean education=11 years). All four of these subjects had lengthy histories of alcoholism, but had abstained from alcohol for at least three weeks prior to testing (average abstinence = 8.3 weeks). Subjects serving as control subjects for the patients with other forms of amnesic were recruited from various locations throughout the Gainesville Veterans Affairs Medical Center. These subjects consisted of five men who were matched to this subgroup of

amnesia patients on the basis of age and education (mean age=46 years; mean education=14.8 years). Analysis of variance procedures failed to reveal any significant differences between the subgroups of amnesic patients and the corresponding subgroup of control subjects or between the pooled amnesic and control groups (all F's less than 1). The mean WAIS-R Full Scale IQ estimate for these control subjects was 105. The mean Wechsler Memory Scale Memory Quotient for these subjects was 114.

Forty introductory Psychology students from the University of Florida were randomly assigned to one of two conditions: subjects in the Malingering group (n=20) were asked to portray "the most severe but believable memory problems" they could on memory tests. Subjects in the Genuine group (n=20) were asked to perform to their maximum capabilities on memory tests.

Head Injured subjects (n=15; nine men and six women) were recruited from several types of populations. The primary criteria for inclusion in this group was the absence of any current or future legal actions on the part of the patient concerning disability or compensation. No Head Injured patient participated in this study under such legal context. Most of these subjects were seeking assistance with academic and vocational rehabilitation. Therefore, no HI patient had readily identifiable incentives to perform poorly and all patients had readily identifiable incentives to perform to their genuine capabilities. Of the outpatient clinic referrals (n=7), two agreed to participate in the study after undergoing a neuropsychological evaluation at the Psychology Clinic at the

University of Florida Health Science Center. The remaining five outpatient Head Injury referrals agreed to participate in the study after undergoing a neuropsychological evaluation at the Mental Hygiene Clinic at the Veterans Affairs Medical Center in Gainesville, Florida. Outpatient CHI patients were paid twenty dollars for their participation. Eight additional Head Injured patients were recruited from the Sandybrook Center of Rebound, Inc., which is located in Mt. Dora, Florida.

Duration of post-traumatic amnesia (PTA) and coma are frequently used indicators of injury severity in the CHI population (c.f., Levin, Benton, & Grossman, 1982). Coma was judged to end when the patient was able to follow verbal commands. Post-traumatic amnesia was judged to end when the patient regained full temporal and personal orientation. In a few cases, this information was unavailable from medical records. In these instances, length of coma and/or PTA was estimated by interview with the patient. Eleven of the 15 patients experienced coma. The median length of coma for these patients was 25 days (range = 1 to 120 days). The median duration of post-traumatic amnesia was 504 hours or 21 days (range = 0 minutes to 44 days). The median length of PTA was lower than the median length of coma because severe and lengthy coma occurred frequently in this sample (11 of 15 patients sustained coma). All of these patients were judged to be fully oriented after their coma resolved. Only one patient did not experience either coma or post-traumatic amnesia, but this patient nevertheless demonstrated significant

concentration and memory problems. On average, patients were tested approximately two years after sustaining their injury (median injury-test interval = 26 months; range = 4 to 73 months). By all accounts, most all of these subjects survived severe head injuries. Those with more minor injuries nevertheless suffered significant neuropsychological impairment.

Clinical characteristics were analyzed as a function of referral setting (inpatient rehabilitation versus outpatient clinic). Exploratory analyses of variance failed to find significant main effects of referral setting on age at time of testing, injury-test interval, duration of coma, or duration of post-traumatic amnesia. Because of this, all HI patients were treated as a single group of patients.

Design

The design of the study consisted of a combination of within-subjects and between-groups factors. The overriding independent variable of interest was group membership: the Malingering group served as the experimental group, the Genuine group served as the normal control group, and the Head Injured group served as the criterion group with bonafide memory impairment. The effect of group membership was observed on all dependent measures deriving from the clinical and experimental memory tasks. Levels of processing were manipulated in a within-subjects manner.

Materials

Preexperimental Materials

An extensive set of materials was necessary for the Genuine and Malingering subjects. A three-subtest short form of the Wechsler Adult Intelligence Scale-Revised, consisting of the Information, Vocabulary, and Block Design subtests (Booker & Cyr, 1986), was employed as an estimate of intelligence. Sattler (1988) endorses this test for clinical use.

Subjects were then given a sheet of paper printed with information about the neuropsychological sequelae of closed head injury. Twenty items of information relating to the memory performance of head injured patients was presented. This fact sheet is contained in Appendix A. Subjects were given adequate time to read carefully through this information.

Instructions to subjects (Genuine and Malingering subjects only) concerning the role they were to play were presented after they had been randomly assigned to either group. The instructions were presented in the context of an imaginary scenario which emphasized the playing of a role during the memory testing phase of the experiment. Appendix A presents the two scenarios used for each group. Both scenarios included a description of an automobile accident which occurred recently in which the person sustained a minor head injury without loss of consciousness; neurological examination results were negative; the person recently began to experience concentration and memory problems; and the person contacted his attorney for advice.

The two scenarios then diverged. The faking scenario stipulated that if the subject could portray memory problems then he or she could be entitled to collect a large sum of money in damages from the other driver; the malingering role was to play "the most severe but believable memory problems" on the ensuing tests. The best possible effort scenario stipulated that the patient may have to resign from his or her lucrative job if he or she was found to have memory problems; the genuine role was to "put forth the best effort, to try to perform as best you can" on the ensuing tests.

Subjects were then given a test concerning their retention of (1) the information concerning memory after closed head injury, and (2) the information pertaining to their particular scenario and role. Appendix B contains this brief test.

Experimental Materials

Clinical memory measures

The clinical memory measures used in this study have all been used extensively to evaluate and describe memory impairment (c.f., Lezak, 1983). Three main clinical memory tests were employed: the Wechsler Memory Scale (WMS) (Wechsler, 1945), the California Verbal Learning Test (CVLT) (Delis, Kramer, Kaplan, Ober, & Fridlund, 1987), and the Rey-Osterrieth Complex Figure test (ROCF) (c.f., Lezak, 1983).

The Wechsler Memory Scale (WMS) (Wechsler, 1945) consists of seven subtests. The subtests which contribute to producing the age-corrected

Memory Quotient (MQ) are Personal and Current Information, Orientation, Mental Control, Logical Memory, Digit Span, Visual Reproduction, and Associate Learning. The Logical Memory and Visual Reproduction subtests were tested again after a 30 minute delay (Russell, 1975). Although the WMS has been frequently criticized (Prigitano, 1978), it continues to enjoy frequent use in characterizing a patient's memory impairment in both the clinic and laboratory (Squire & Shimamura, 1986). At the inception of this study, the original WMS was used instead of the Wechsler Memory Scale-Revised (Wechsler, 1987) because the latter had not yet gained widespread acceptance and clinical usage.

The California Verbal Learning Test (CVLT) was employed as a measure of list learning. This test is composed of repeated presentations of a list of 16 words. The structure of this test provides information about the amount of information learned, the rate of learning over trials, encoding strategies employed, error analysis, persistence of memory over retention intervals, and the use of assisted retrieval. All test protocols were scored with the accompanying microcomputer software (Fridlund & Delis, 1987).

The Rey-Osterreith Complex Figure Task (ROCF) was employed as an index of drawing from memory or nonverbal memory. The subject completed three separate tasks associated with the ROCF. The subject first copied the figure and then immediately drew the figure from memory. The subject again drew the figure from memory, this time after a 30 minute delay.

Several nonverbal clinical memory tests were employed primarily as interpolation tasks occurring between the immediate and delayed testing of verbal memory tasks. Forms C, D, and E of the Benton Visual Retention Test (Benton, 1974) and the Milner Facial Recognition Test (Milner, 1968) were used for this purpose. These data were not scored or analyzed.

Experimental memory tasks

A total of 120 low (less than 30 occurrences per million) and high frequency (between 60 and 200 occurrences per million) words were selected from Kucera and Francis (1967) according to the following criteria. Each word had between five and eight letters. The first three letters of each word (i.e., stem) uniquely defined each word in the set. However, each word stem was common to at least 10 different words in Webster's Pocket Dictionary. The total pool of words was randomly divided into four subsets, with 25 words used for the study and test of Word Stem Completion (WSC), 45 words used for the study and test of Perceptual Identification (PI), 25 words used for the study and test of Free Recall (FR), and 25 words used for the study and test of Multiple Choice Recognition (MCR). Therefore, each experimental paradigm (WSC, PI, FR, and MCR) had individual study and test lists which were administered independently of lists associated with the other tasks in order to prevent contamination at testing.

The first two and last three words of each study list contained "filler" words which served as buffer items to control for primacy and recency effects.

The remaining words were target words. Within each task, each word was randomly assigned to a processing condition which either focused subject's attention on the semantic/conceptual aspects or the physical/orthographic aspects of the particular word. The processing tasks were adapted from Craik and Tulving (1975). The semantic encoding condition had subjects verify whether the word would make sense if inserted in a specified place in a sentence by responding with "yes" or "no." The physical encoding condition had subjects verify whether a word contained a specified letter by responding with "yes" or "no." Within each processing condition, the correct answer ("yes" versus "no") for the word's processing task was randomly assigned. The proportion of correct "yes" and "no" responses were equivalent within orienting conditions and within study lists. Appendix B provides the complete study and test lists used in the four experimental memory tasks.

Word stem completion (WSC). A pool of 25 words was used for WSC. The 20 target word were divided into two separate lists of 10 words each, List A and List B. Each subject studied only one of the two lists. Five words were encoded with a semantic processing task and five words were encoded with a physical processing task. WSC study lists (A versus B) were counterbalanced within group. The five words used as primacy and recency buffers were invariant across both lists. Study words were printed on four by six inch white index cards. At test, each subject was given a sheet of paper with 20 word stems and asked to complete the stems to form the first words that came to his

or her mind. Ten of the stems could be completed to form the target words which were studied. The remaining 10 unexposed words were used as distractor stimuli. The percentage of these words completed in the target direction served as baseline performance.

Perceptual identification (PI). A pool of 45 words were used for WSC. Subjects studied a group of 25 words. Five words were used as primacy and recency buffers. Of the remaining 20 words on the study list, 10 words were encoded with a semantic processing task and 10 were encoded with an physical processing task. Study words were printed on four by six inch white index cards. The PI test list consisted of 40 words, the 20 target words plus 20 unexposed distractor words. Assignment to serial position in the test list was random. A yes/no recognition test followed the PI task; it consisted of the same 40 words.

Free recall. A pool of 25 words were used for FR. The FR study list was composed of five buffer words, 10 words which were encoded in a semantic processing task, and 10 words which were encoded in an physical processing task. Study words were printed on four by six inch white index cards. Subjects made their FR responses on a sheet of lined paper. Buffer words produced at test were not counted as correct.

Multiple choice recognition. A pool of 25 words were used for MCR. The MCR study list was composed of five buffer words, 10 words which were encoded in a semantic processing task, and 10 words which were encoded in

an physical processing task. Study words were printed on four by six inch white index cards. The testing of MCR involved the subject circling the word, out of four possible choices, which he or she recognized as studying previously.

Symptom validity testing

Stimuli for Symptom Validity Testing (SVT) was comprised of a series of seven digit numbers. Stimuli were presented and subjects made their responses on an IBM-compatible personal computer. A software program was written using Micro Experimental Laboratory (M.E.L.) (Schneider, 1988, 1989). Appendix B contains the study digit strings, the digit strings serving as the test foils, and the correct answer for that trial. Fifty complete trials were constructed and comprised trials one through 50. The same trials were then repeated in the same order for trials 51 through 100. Correct answers (either "A" or "B") were randomly assigned. Alternative "A" was correct on 50 trials while "B" was correct on the remaining 50.

The numbers comprising the digit strings were not randomly generated; rather, several patterns were built into the stimuli in an attempt to "entice" the Malingering subject into perceiving the task as more difficult than in actuality. For all trials, the target and foil digit strings began with different digits. The digit strings always differed as to odd versus even status. All target digit strings contained two contiguous digits which were the same number (e.g., 8160833),

while the foil string did not contain such a pattern. Thus, correct answers could be made the basis of remembering several simple ideas.

Procedure

Preexperimental Procedures

All subjects completed the informed consent form. Testing in the main phase of the study was then begun with Amnesic patients, amnesic control subjects, and Head Injured patients.

An extensive pre-experimental procedure was necessary for the college normals who participated as Genuine and Malingering subjects. These subjects were administered the WAIS-R short form. Subjects were then asked several open-ended questions concerning their medical and neurological history. No subjects were included with a positive history of neurological illness or learning disability.

Prior to the subject's receiving his instructions, his or her threshold for perceiving words was determined in the following manner. Using 35 msecs as the predicted average perceptual threshold, the method of limits was employed in both a descending and ascending manner. In the descending method, the sample word was flashed on the tachistoscope for 60 msecs and the subject attempted to name the word. Additional trials were repeated, using a different word each time, by decreasing the duration of exposure by five msecs each repetition until the subject could no longer read the word. The ascending method was then employed. This differed only in that the starting exposure

duration was well below threshold at 10 msec. Repeated trials were presented with different words by increasing the duration of exposure by five msecs each repetition until the subject correctly read the words. An individual subject's perceptual threshold was computed as the mean of the two thresholds obtained using the ascending and descending method of limits. The duration of exposure of PI test words was set approximately 5 msecs below the individual subject's perceptual threshold.

Subjects were then given a sheet of paper printed with information about the neuropsychological sequelae of closed head injury. Twenty items of information relating to the memory performance of head injured patients was presented. Subjects were given adequate time to read carefully through this information.

As it was originally planned, Genuine and Malingering subjects were to attempt to keep the tester (the primary experimenter) from "catching on" to their particular role. This aspect of the procedure had to be abandoned for several reasons, however, after eight subjects were run. Most importantly, the idea of fooling the tester and escaping detection added a layer of complexity to the situation, making it quite confusing for some Malingering subjects. Another effect of this procedure was that Malingering subjects interpreted this to mean that they should emphasize behavioral presentation (i.e., their dramatic or acting ability) rather than their scorable test-taking behavior. Finally, the requirement to convince the tester cast a somewhat adversarial atmosphere

which tended to obscure the purpose of the study and made some Malingering subjects anxious. During the de-briefing, one subject stated that she quit playing her role "somewhere in the middle" due to these issues.

The solution to these problems was as follows. The principal investigator continued to test subjects due to (1) the potential for anxiety; (2) the need to thoroughly assess compliance with the role-playing; and (3) the need to maintain consistency of testers across the Head Injured group. However, the requirement that subjects were to "fool" or deceive the examiner was de-emphasized. Emphasis was instead placed on the subject's test-taking behavior. The subjects were told that, just as they would be playing a role, the principal investigator would be playing the role of the tester. Subjects were told that all aspects of the tester's behavior would be strictly according to test administration instructions and procedures and at no time would the tester initiate an interruption of the role-playing procedure or portray a "confrontation" with the "suspected faker." This approach worked quite well in that 100% compliance with instructional conditions was obtained; no subject refused or interrupted participation. No subject developed an adverse reaction to participation. The perfect compliance rate should be contrasted with the results of Heaton, Smith, Lehman, & Vogt (1978) in which 44% of their subjects instructed to malinger were rated as investing a "questionable" amount of effort in their role.

The principal investigator remained blind to group assignment. Subjects drew a number out of an envelope which served as the basis for randomized group assignment. Subjects were left alone in a small testing room in the Neuropsychology Laboratory with two folders which separately contained the materials pertaining to the Genuine and Malingering groups. Subjects indexed which group they had been assigned to and proceeded to read the materials in that folder. After reading the pre-experimental material, they completed the brief true/false test concerning their retention of (1) the information concerning memory after closed head injury, and (2) the information pertaining to their particular scenario and role. Incorrect answers to questions about head injury were corrected and discussed with the subjects; therefore, the subjects learned this information to 100% accuracy.

The role-playing aspects of this study were then discussed further with the subjects. As the primary experimenter was blind to group membership, aspects of the Genuine and Malingering roles were discussed with each subject, regardless of group assignment. This offered the additional benefit of putting the role-playing into a clearer perspective for each subject. That is, Genuine subjects gained a better understanding of how their role-playing related to the Malingering role-playing and vice versa. All subjects were forewarned to expect difficulty with playing their role. They were told that only objective aspects of their behavior was of interest to the experimenter; that is, they were not being judged on "acting ability" or "dramatic believability." Finally,

they were encouraged to not cease playing their role until the experimenter said "Stop playing your role, the experiment is over." Subjects were given approximately five to seven minutes of free time to use to plan their role-playing. They were encouraged to review the fact sheet and to mentally rehearse their role.

Overview of Experimental Procedures

The main phase of the experiment was grouped into three blocks of tests. The verbal/nonverbal nature of the memory tasks as well as the requisite delay intervals for the clinical memory tests were the main considerations in ordering the test battery. Form E of the Benton VRT was used at any point where additional nonverbal distractor activity was necessary to maintain correct delay intervals. The first block of tests consisted of the immediate testing of the WMS Logical Memory and Visual Reproduction subtests. The SVT paradigm was administered next. The delayed testing of the WMS Logical Memory and Visual Reproduction subtests closed out the first block of tests.

The second block of tests began with the administration of the copy and immediate memory trials of the Rey-Osterreith Complex Figure Test. The four experimental memory tests (WSC, PI, FR, and MCR) were then administered next. The order of these four tasks was counterbalanced within groups. Four to five minute interpolated delay intervals occurred between the study and test phases of all four experimental memory tasks. The forward portion of the WMS Digit Span subtest was used at the distractor activity for WSC. The backward

portion of the WMS Digit Span subtest was used as the distractor activity for PI. The WMS Orientation and Personal and Current Information subtests were used as the distractor activity for FR. The WMS Mental Control subtest was used as the distractor activity for MCR. The second blocks of tests concluded with the delayed memory trial of the ROCF. The third block of tests began with the study and immediate testing trials of the CVLT. Forms C and D (and E if necessary) of the Benton VRT were then administered, followed by the Milner Facial Recognition Test. The 20 minute delayed testing of the CVLT followed. Testing culminated with administration of the WMS Associate Learning subtest.

Experimental memory procedures

For Study 1, a computer software program was written which presented study words and corresponding orienting questions to the Amnesic patients and the control subjects. Several factors necessitated a change in presentation of stimuli in Study 2. The computerized version required too much administration time. Additionally, some Malingering subjects portrayed problems in interacting with the computer, causing it to become inoperable on several occasions. Therefore, the following modifications were made for all subjects participating in Study 2.

Word stem completion. Each subject studied either WSC List A or List B. Words were printed on four by six inch white index cards. Subjects held the deck of cards. They were told their task was to answer questions about words; no reference was made to the memorial aspects of the study episode.

The experimenter read aloud the corresponding processing question. The subject made his response verbally. After responding, the subject proceeded to the next word. Following the distractor task, the subject was then given a sheet of paper with 20 word stems and asked to complete the stems to form the first words that came to mind. No reference was made to the study list. Subjects were encouraged to complete the stems in the order listed. After completing all 20 word stems to form words, each subject then was asked to mark "Y" by each words which he or she explicitly remembered from the study list. This is a variant of the traditional paradigm used to analyze stochastic independence (e.g., Jacoby & Witherspoon, 1983). In these studies, subjects are given the original study words with which to make yes/no recognition judgements. In the current study, subjects made recognition judgements based on the words which they produced.

Words were scored as correct only if they were exactly the same word as was studied. Correct performance was calculated as the proportion of words correctly completed in the target direction. Correct completion was also calculated within each processing condition. Baseline performance was calculated as the proportion of unexposed distractor words completed in their target direction. Thus, each subject served as his or her own control by producing words to distractor stems.

Perceptual identification. Subjects studied the PI study list in the same manner as above. They were told their task was to answer questions about

words; no reference was made to the memorial aspects of the study episode. A four-channel Gerbrands tachistoscope equipped with a voice-activated response timer was used to present the stimuli. At PI testing, target words were tachistoscopically presented one after another at a fixed exposure duration in the following manner. After a subject signaled his readiness to proceed, an orienting stimulus was exposed on the screen for 500 msec indicating to the subject where the word was to be presented. The word was then exposed for the appropriate duration, followed immediately by a mask which remained for 2 seconds. The subject attempted to read the word as quickly as he could. The subject's verbal answer and response latency were recorded for each trial. This was repeated for every word in the test list. After the PI test, subjects were given a list of the same 40 words and asked to circle "Y" or "N" based on whether they recognized the word from the study list. (Note: this procedure conforms directly with the traditional procedure used to compute stochastic independence.). Responses were scored as correct only if they were exactly the same word as was studied. Correct performance was calculated as the proportion of target words correctly identified. Correct identification rate was also calculated within each processing condition. Baseline performance was calculated as the proportion of distractor words correctly identified. Thus, each subject served as his or her own control by attempting to identify distractor words.

Free recall. Subjects studied the FR study list in the same manner as above. They were told their task was to answer questions about words; no reference was made to the memorial aspects of the study episode. After the distractor task, subjects were given a sheet of lined paper and asked to "write down all the words you can remember from the previous list of words you studied". Responses were scored as correct only if they were exactly the same word as was studied. Correct performance was calculated as the proportion of target words correctly recalled. Correct recall was also calculated within each processing condition.

Multiple choice recognition. Subjects studied the MCR study list in the same manner as above. They were told their task was to answer questions about words; no reference was made to the memorial aspects of the study episode. After the distractor task, subjects were given a sheet of paper printed with 20 items consisting of four words and asked to "circle one word from the four choice that they remember from the previous list of words you studied." Correct performance was calculated as the proportion of target words correctly recognized. Correct recognition was also calculated within each processing condition.

Symptom Validity Testing

The SVT task began with a list of instructions presented to the subject on the screen. The examiner verbally explained the directions as well, emphasizing the "extremely difficult" aspects of the test. The subject then pressed the space

bar to begin the testing. The first target string was presented in the middle of the screen for a total of two seconds, after which it was briefly covered with a mask for one second. The screen immediately cleared, presenting the subject with two different digit strings, the correct target string and an incorrect foil string. The string presented on the left side of the screen was labeled as "A" and the string presented on the right side of the screen was labeled as "B". Labels marked "A" and "B" were placed on the F and J keys on the keyboard, respectively. Subjects held both index fingers on these keys throughout testing. Subjects made their responses by first hitting the corresponding key and then calling out their answer. Unfortunately, the computer software failed to properly record the reaction times for the subjects. As a contingency to this problem, the examiner unobtrusively sat behind the subjects and manually recorded response latencies with a stopwatch. Reaction time data derived from the SVT paradigm was subsequently analyzed but interpreted with the inherent unreliability of the data collection method taken into account.

Clinical Memory Procedures

The WMS consists of seven subtests. Personal and Current Information consists of six questions which tap recall of long established verbal information. Orientation consists of five questions which tap immediate temporal orientation. Mental Control consists of three subtasks, all of which are completed under time pressure: counting backwards from 20; repeating the alphabet; and counting in increments of three's. Logical Memory consists of two literary

passages. The task for the subject was to recall a number of ideas contained in the passages. The subject was asked to repeat this recall procedure after a 20-25 minute delay interval. Memory Span consists of recalling verbally presented digits in the forward and backward directions. For each Digits Forward and Digits Backward, the score was the maximum number of digits recalled. Visual Reproduction consists of drawing geometric designs that were presented visually for a brief period of time. The subject was also asked to repeat this reproduction procedure after a 20-25 minute delay interval. Associate Learning consists of the subject learning two word associations and then recalling the correct target word when given the stimulus word.

On the California Verbal Learning Test, the subjects were read five presentations of a list of 16 words. After each presentation, the subject was asked to repeat, in any order, the words on the list. After the fifth presentation, a second list was presented. After this trial, the first list was tested for a short delay free recall and short delay cued recall, and followed later by a twenty minute free recall, twenty minute delay cued recall, and twenty minute delay recognition.

The Rey-Osterreith Complex Figure Task (c.f., Lezak, 1983) required the subject to complete three separate tasks. The subject copied the complex figure, drew the figure from memory immediately after copying it, and drew the figure from memory after a 30 minute delay period. The drawings were scored by a neuropsychometrician with extensive experience with this test who was

blind to group membership. The drawings were scored separately for each of eighteen units. Each unit was scored for presence or absence, placement, distortion, and recognizability according to the criteria specified by Lezak (1983). Each trial yielded one overall score derived from the summation of the points earned for each of the eighteen units.

Twenty five percent of the subjects of each group were randomly sampled and re-scored by the primary experimenter who was also blind to group membership. Reliability coefficients demonstrated very high inter-rater agreement for the copy ($r=0.99$), the immediate reproduction ($r=0.99$), and the delayed reproduction ($r=0.99$). In 32 of 39 cases, summary scores from the two raters did not differ by more than one point.

Debriefing

Given the nature of this study, subjects in the Genuine and Malingering conditions were interviewed at length about their experiences and perceptions while playing their respective roles during the experiment. Immediately after the role-playing phase of their participation, subjects in the Genuine and Malingering groups were given verbal descriptions of many of the memory tasks they completed and asked to make Likert ratings concerning their (1) effort put forth while completing that particular test; (2) perceptions of the difficulty of the task (for a "normal" person with genuine motivation); and (3) perceived success at portraying their role on that task. Twenty two tasks were described; each subject rated the three characteristics for each task on a

seven-point scale. The three scales were anchored in the following manner. A rating of one indicated the least amount of effort, task difficulty, and perceived success. A rating of seven indicated the most amount of effort, task difficulty, and perceived success. A rating of four represented the midpoint of each scale. The form used for obtaining these ratings is presented in Appendix C.

Next, subjects were presented with their responses on the experimental memory tasks and SVT in order to probe for several specific questions. Subjects were asked several open-ended questions during the debriefing interview concerning their performance on these tasks. As regards the indirect memory tests, subjects were asked (1) "During WSC (and PI), did you recognize that some of the words you generated were actually studied on a previous deck of words?"; and (2) "During WSC (and PI) did you ever use your conscious memory to deliberately think back to the study episode try to respond with target words you remembered studying?". Based on their answers to these questions, subjects were classified as to whether they experienced test awareness, and whether they consciously employed their explicit memory for test words to either facilitate or suppress their performance on the indirect memory tests.

The subject's de-briefing ratings were scanned by the principal investigator for any notable responses, which were then discussed with the subject. Subjects were then given a chance to discuss their perceptions and feelings about their role playing and to ask any further questions.

CHAPTER 3
RESULTS

The first part of the results section will provide descriptive and demographic information in order to fully characterize the composition of the five experimental groups. Results from Experiment 1 involving the amnesic patients and controls will be presented with the goal of establishing the concurrent validity of the experimental memory tasks as representative of those found in the literature. Extensive results from Experiment 2 involving the Genuine, Malingering, and Head Injury subjects will then be presented.

A note concerning the use of various statistical procedures is warranted. The use of multivariate analysis of variance procedures (MANOVA) will be employed only when analyzing multiple response variables which represent theoretically dissociable constructs of memory functioning (e.g., free recall of verbal material, cued recall of verbal material, etc.). This will protect against an inflated experiment-wise error rate. Inflated comparison-wise error rates will be controlled by employing additive (Bonferroni) error splitting. In this case, alpha levels will be divided by the number of comparisons made on related variables.

Descriptive Statistics

Characterization of Subject Groups

Table 2 contains descriptive information and demographic variables for Experiment 1. The Amnesic patients were broken down into two subgroups based on etiology: alcoholic Korsakoff's syndrome (n=4) and other etiologies (n=5). A control group consisting of medical outpatients was matched to the two amnesia subgroups based on age and education. One-way analysis of variance procedures showed no significant differences between the amnesic subjects and controls for the demographic variables. Table 3 contains descriptive information and demographic variables for the main study. Two groups of normal college students comprised the Genuine (n=20) and Malinger (n=20) groups. Patients suffering from Closed Head Injury (n=15) were included as an additional control group. One-way analyses of variance showed significant differences between the three groups on age at time of testing, $F(2,52)=7.09$, $p<.01$. Follow-up mean contrasts revealed that Head Injury patients were significantly older than the Genuine and Malinger subjects. As memory function has been repeatedly shown to decline as a function of age, the observed age effect in the present study could theoretically pose a threat to the validity of the results. However, the observed statistical difference in age between the Head Injury subjects and the other groups is slight (approximately 5 years) and does not represent a practically significant difference.

Correlations and covariances were computed between age and the response variables for (1) the overall sample, and (2) by each subject group separately. The results indicated that age was not statistically related to any response variable, both for the overall sample and within each subject group. Nevertheless, age was used as a covariate in all between-group analyses for the main experiment.

A similar pattern of results was noted for Full Scale IQ, $F(2,52)=9.88$, $p<.001$, with Head Injury subjects showing significantly lower FSIQ estimates than the Genuine or Malingering subjects, which were not significantly different from the other. A one-way analysis of variance showed no significant differences between the three groups on level of education at time of testing, $F(2,52)=2.03$, $p<.14$. Lowered FSIQ is one manifestation of the neuropsychological sequelae of head injury. Because differences between Genuine and Malingering subjects cannot be explained by FSIQ differences, FSIQ was not treated as a covariate. It could be argued that the difference in education level between the college groups and the head injured patients was clinically significant, even though this difference failed to reach statistical significance. However, eleven of the head injury patients had completed their high school diploma. Three had completed at least one year of college and six other were reportedly enrolled in college prepatory classes prior to their injury.

Table 2
Descriptive Information for Experiment 1

Variable	Group	
	Amnesia	Controls
Number of Subjects	9	9
Age		
Mean	54.7[A]	56.3[A]
SD	15.4	13.8
F(1,16) = 0.06		
Education		
Mean	14.2[A]	13.1[A]
SD	3.6	3.6
F(1,16) = 0.43		
Full Scale IQ		
Mean	102.6[A]	104.7[A]
SD	15.3	9.4
F(1,16) = 0.12		
Mattis DRS Total		
Mean	131.5[A]	135.3[A]
SD	4.2	6.5
F(1,16) = 1.27		

* $p<.05$ ** $p<.01$ *** $p<.001$

Note. Means with different superscripts differ significantly at $p<.05$.

Table 3
Descriptive Information for Experiment 2

Variable	Group		
	Genuine	Malinger	Head Injury
Number of Subjects	20	20	15
Age			
Mean	21.1[A]	21.6[A]	26.9[B]
SD	3.6	5.1	6.1
F(2,52) = 7.09**			
Education			
Mean	12.9[A]	12.8[A]	12.3[A]
SD	1.0	0.8	1.1
F(2,52) = 2.03			
Full Scale IQ	108.3[A]	110.3[A]	92.4[B]
Mean	11.5	14.0	12.1
SD			
F(2,52) = 9.88**			

* p<.05 ** p<.01 *** p<.001

Note. Means with different superscripts differ significantly at p<.05.

Normality of Data

All response variables were examined for skewness, kurtosis, and normality of distribution to determine the need for transformation of the raw scores. The response variables included those derived from percentage of correctly produced targets from WSC, PI, FR, and MCR as well as reaction times for PI and SVT. In all cases, the raw data adequately conformed to the parameters necessary to satisfy the analysis of variance procedure assumption of approximate normality.

Experiment 1: Validation of Word Lists

The results of statistical tests will be reported in the following order. First, main effects (target status, orienting task, answer status, etc.) collapsed across groups will be reported. Next, statistical interactions between group and these other variables will be reported. Regardless of the statistical significance of these interaction terms, these main effects (target status, orienting task, answer status) will be analyzed separately within each group in order to document whether each group produced the hypothesized pattern of performance.

Word Stem Completion

Each subject in the present study served as his own control subject in that chance or baseline performance on the stem completion task was determined by the percentage of distractor (new) words completed in the target direction. Baseline performance for the two groups (Amnesia=7.7%;

Controls=10%) was not significantly different, $F(1,16)=.30$, $p<.59$, and was equivalent to baseline rates reported in the literature (Graf & Williams, 1987). Collapsed across groups, a significant main effect of word status (target versus distractor) was found, $F(1,16)=30.9$, $p<.0001$. Computed within groups, a significant main effect of target status was found for both the Amnesic group, $F(1,8)=16.96$, $p<.003$, and the control group, $F(1,8)=21.56$, $p<.002$. These findings suggest that both Amnesic and control groups demonstrated priming on the WSC task. Follow-up mean comparisons confirmed that word stems were completed in the target direction significantly more often when the word was previously exposed compared to the unexposed condition. The interaction between group and target status was nonsignificant, $F(2,16)=0.00$, $p<.97$, suggesting that the strength of priming was similar in Amnesics and controls. Figure 1 presents this data. Collapsed across groups, the main effect of orienting task was nonsignificant. Additionally, the interaction between group and orienting task was nonsignificant (F's < 1). Control subjects showed a slight trend towards higher percent correct stem completion when the target words were encoded in the physical orienting condition, while Amnesic subjects showed virtually identical performance in both orienting conditions.

An alternative analytic approach involved computing a binary variable which reflected whether or not each subject demonstrated priming on stem completion. For each subject, baseline performance for that subject was subtracted from target performance, resulting in a variable which reflected the

magnitude of priming. Using a conservative cutoff of a 25% increase in performance of targets over distractors, each subject was scored as to whether his WSC performance reflected priming or no priming. This criterion reflected the average strength of priming demonstrated in the relevent literature. Five of 9 amnesic subjects (55.6%) demonstrated priming using this criterion, compared to 6 of 9 control subjects (66.7%). A nonparametric hypothesis test for the significance of difference between these two proportions failed to reach significance ($Z=-.48$, $p<.32$).

Perceptual Identification

Baseline performance on Perceptual Identification (PI) for the two groups (Amnesia=22.2%; Controls=20.6%) was not significantly different (F's < 1), and was equivalent to baseline rates reported in the literature (Jacoby & Dallas, 1981). Collapsed across groups, a significant main effect of word status (target versus distractor) was found, $F(1,16)=27.1$, $p<.0001$. Computed within groups, a significant main effect of word status was found for both the Amnesic group, $F(1,8)=6.33$, $p<.03$, and the control group, $F(1,8)=12.27$, $p<.008$, suggesting that both groups demonstrated priming on the PI task. Follow-up mean contrasts confirmed that stimulus words were identified significantly more often when the word was previously exposed compared to the unexposed condition in both groups. The interaction between group and target status was nonsignificant ($F < 1$). Figure 2 presents this data.

Collapsed across groups, the main effect of orienting task was nonsignificant. The interaction between group and orienting task was also nonsignificant (all F's < 1). Both groups showed virtually identical performance in the sentence and letter orienting conditions.

A binary variable reflecting whether a subject demonstrated priming on perceptual identification was computed in the same manner as discussed above, using a 25% increase in performance of targets over distractors as the marker for priming. Four of 9 amnesic subjects (44.4%) demonstrated priming, compared to 3 of 9 control subjects (33.3%). A nonparametric hypothesis test for the significance of difference between these two proportions failed to reach significance ($Z=-.48$, $p<.32$).

Free Recall

The main effect of group on free recall performance was highly significant, $F(1,16)=25.29$, $p<.0001$. Amnesic subjects demonstrated grossly impaired explicit memory as measured by free recall of previously presented words. Within-group analyses of variance showed that the main effect of orienting task was nonsignificant for the Amnesic group, $F(1,8)=.00$, $p<.1.0$, but was highly significant for the control group, $F(1,8)=14.81$, $p<.005$. A follow-up mean contrast test established that control subjects recalled significantly more words which were encoded in the conceptual orienting condition (mean=27.8%) than words encoded in the physical orienting condition (mean=5.6%). A floor effect likely prevented amnesic subjects from showing

the expected free recall advantage afforded by the conceptual orienting condition. Their grossly impaired explicit memory likely prevented them from learning any new information. The interaction between group and orienting task was also highly significant, $F(1,16)=12.90$, $p<.002$, with control subjects showing a significantly greater levels of processing effect than Amnesic subjects. Figure 3 presents this data.

Multiple Choice Recognition

The main effect of group on multiple choice recognition performance was highly significant, $F(1,16)=47.06$, $p<.0001$. Amnesic subjects demonstrated grossly impaired explicit memory (mean=45%) as measured by multiple choice recognition of previously presented words when compared with control subjects (mean=78.3%). The MCR performance of Amnesics subjects was not significantly greater than chance performance ($Z=1.39$, $p<.08$). The interaction between group and orienting task was nonsignificant, $F(1,16)=.05$, $p<.82$, with Amnesic and control subjects showing equivalent orienting task effects. Figure 4 presents this data.

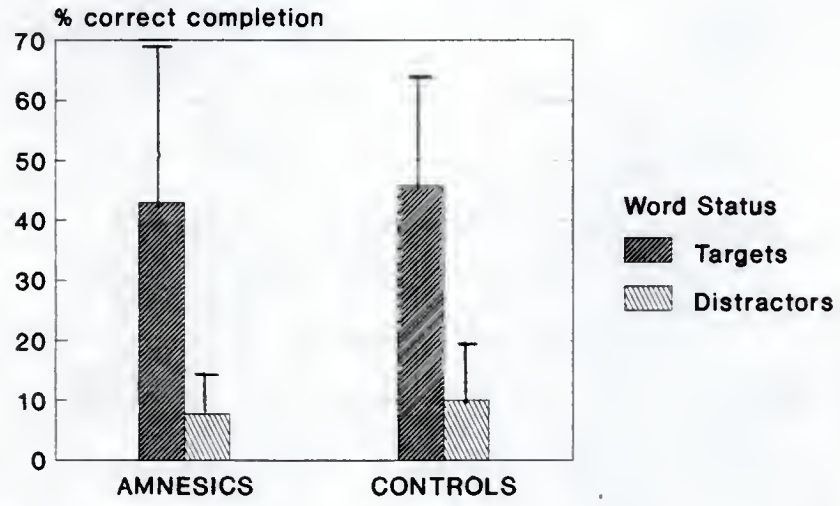
Experiment 2: Main Study

Validity of Group Membership: Clinical Memory Performance

The data generated from the clinical memory tests were used as a validity check to establish that each subject group produced a pattern of performance similar to that reported in the literature. Performance on clinical memory tests provides an easily interpretable benchmark upon which to later

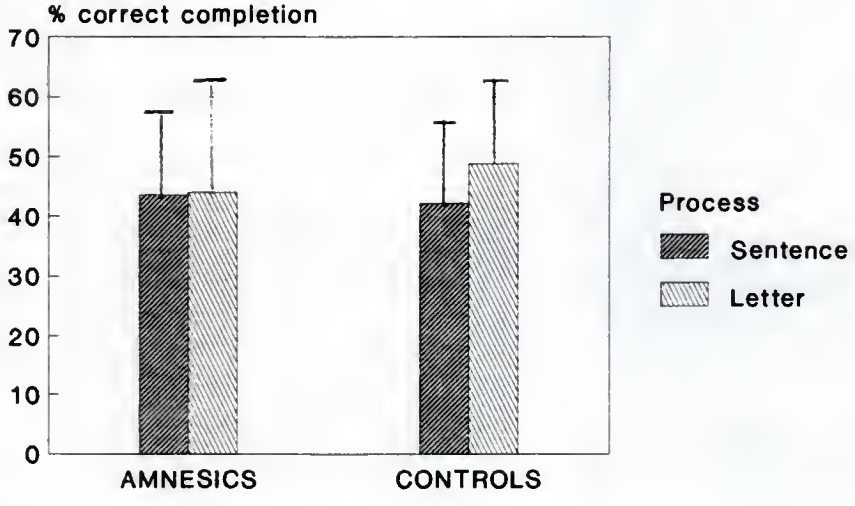
WORD STEM COMPLETION

Target Advantage



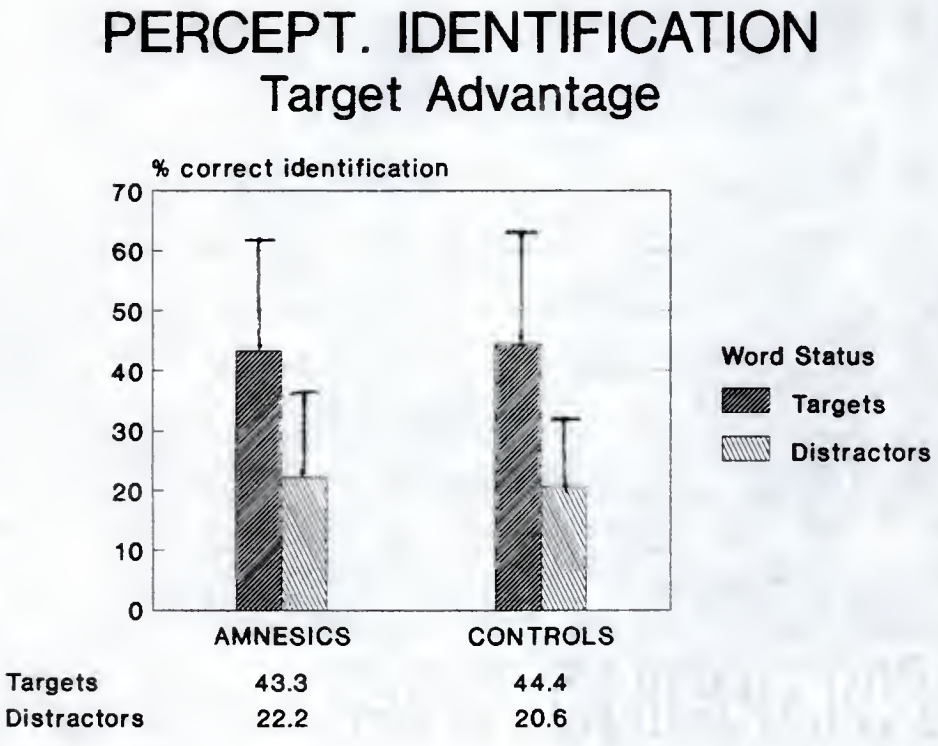
	AMNESICS	CONTROLS
Targets	42.9	45.6
Distractors	7.7	10

Encoding Process

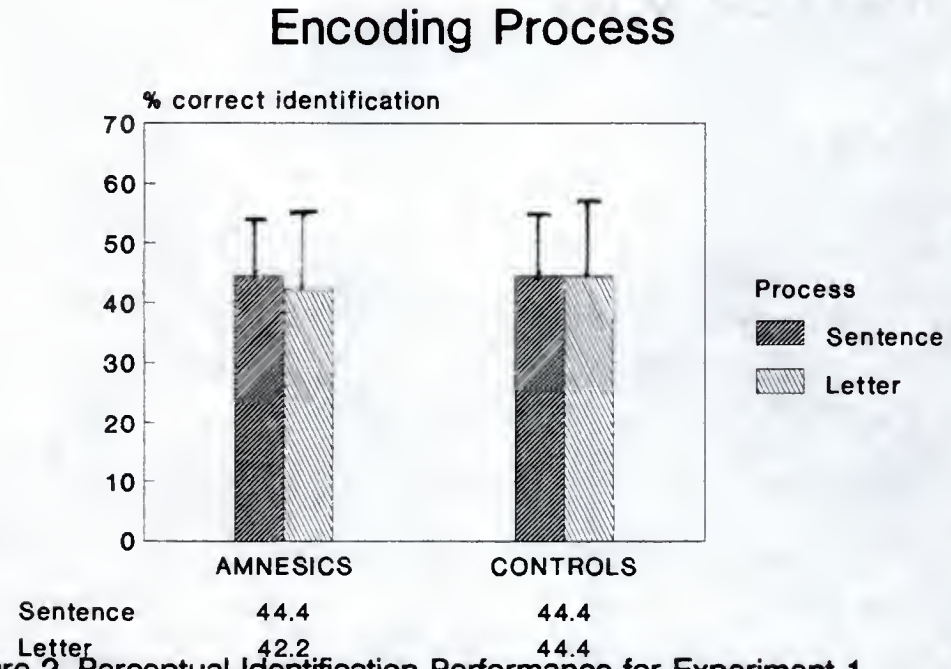


	AMNESICS	CONTROLS
Sentence	43.6	42.2
Letter	44	48.8

Figure 1. Word Stem Completion Performance for Experiment 1.



	AMNESICS	CONTROLS
Targets	43.3	44.4
Distractors	22.2	20.6



	AMNESICS	CONTROLS
Sentence	44.4	44.4
Letter	42.2	44.4

Figure 2. Perceptual Identification Performance for Experiment 1.

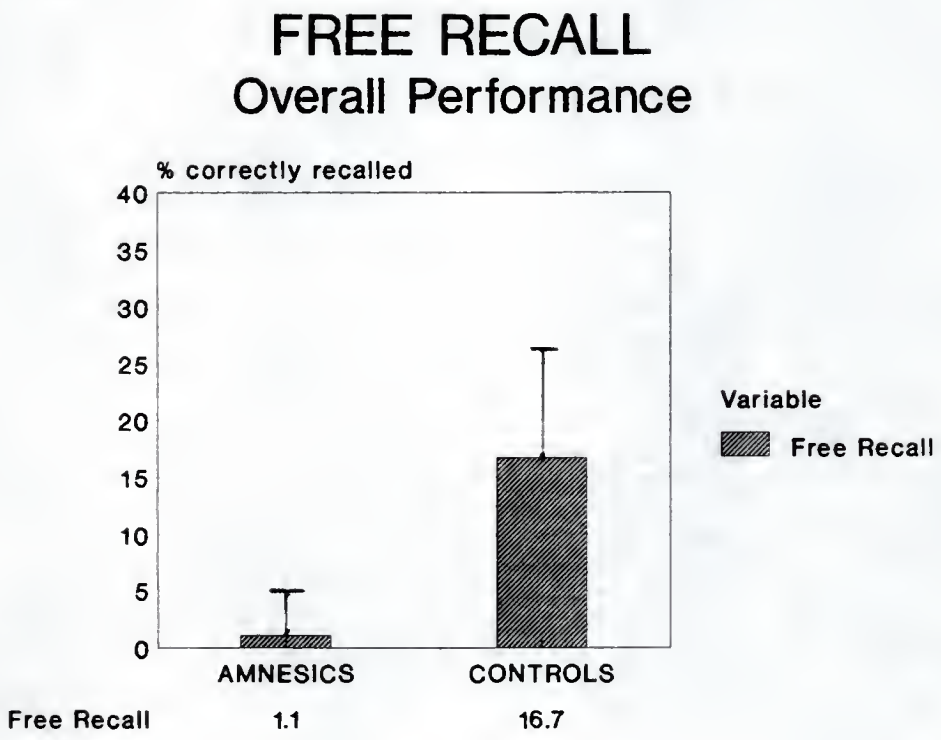
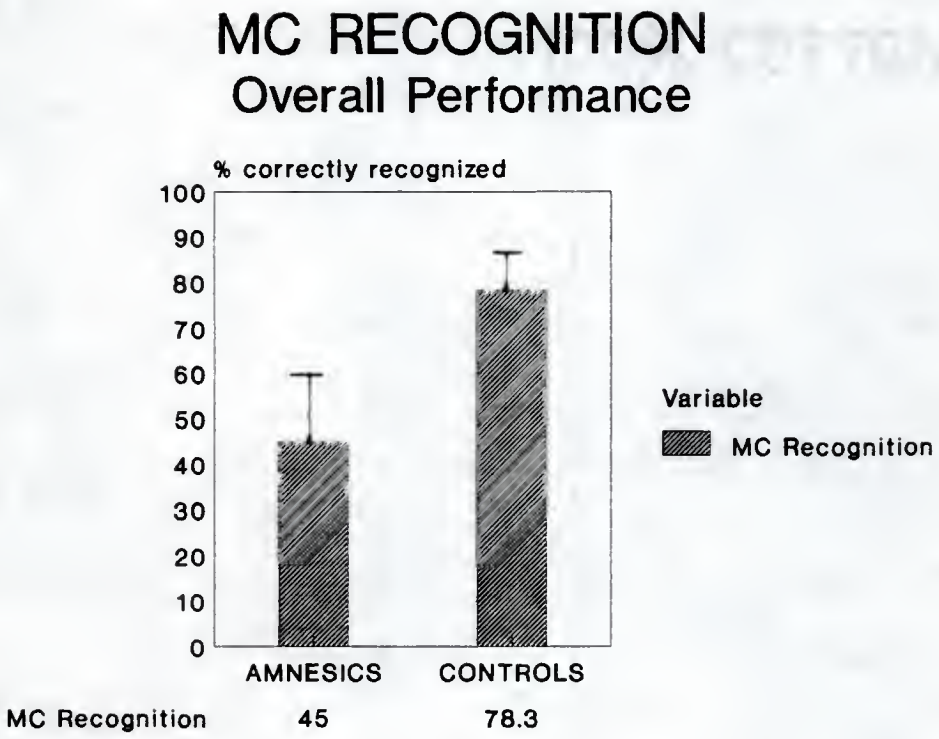


Figure 3. Free Recall Performance for Experiment 1.



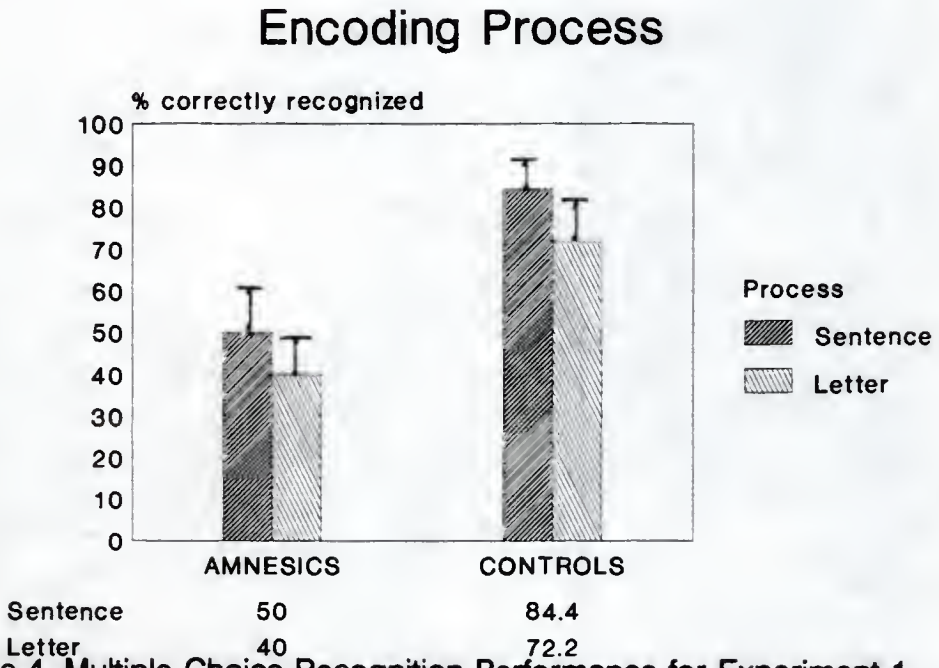


Figure 4. Multiple Choice Recognition Performance for Experiment 1.

understand performance on laboratory-based experimental memory tests. Specifically, performance on clinical memory tests will be used to demonstrate that (1) subjects in the Genuine condition demonstrate intact if not above average memory abilities, and (2) Head Injury subjects manifest impaired attention, concentration, and recent memory abilities. The performance of Malingering subjects on clinical memory tests will allow a thorough characterization of their memory behavior.

Selected clinical memory variables were identified from a larger dataset based on common clinical usage and a priori knowledge of their construct validity. Next, memory processes were classified along two dimensions which have been shown to be sensitive to clinical memory disorders. Distinctions about the quantitative aspects of memory performance, which refers to the extent or capacity of memory functioning, were made on the basis of temporal, material, and retrieval-process divisions. Eighteen variables comprised the variable set representing quantitative memory functioning. Qualitative aspects of memory performance, which refers to those characteristics of memory behavior not directly related to capacity of memory, were also analyzed. For example, the number of false positive errors provides useful data concerning a subject's response tendencies. Ten variables comprised the variable set representing qualitative aspects of memory functioning. For each memory process, a multivariate analysis of variance was first computed. Significant

MANOVAs were followed with multiple univariate analyses of variance of the constituent variables.

Quantitative variables

Eighteen variables comprised the variable set representing quantitative memory functioning. Table 4 presents the specific memory processes, the constituent clinical variables which tap the processes, and MANOVA results. Univariate ANOVA alpha levels for these comparisons were corrected to provide Type I error protection, yielding an alpha level of .003 as the criterion necessary to obtain statistical significance (alpha of .05/18 comparisons=.0027). Table 5 presents this data.

Composite, general memory functions. A MANOVA performed on the set of variables representing composite, general memory functions was highly significant, Wilk's Lambda $F(4,100)=12.26$, $p<.0001$. Univariate ANOVA procedures showed significant main effects of group on WMS Memory Quotient, $F(2,51)=17.13$, $p<.0001$, and CVLT Total of Trials 1 to 5, $F(2,51)=17.13$, $p<.0001$. Follow-up mean contrasts showed that Genuine subjects produced significantly higher scores on these two indices than either Malingering or Head Injury groups, which were not significantly different from each other.

Attention and concentration. A MANOVA performed on the set of variables representing attention and concentration functions was highly significant, Wilk's Lambda $F(6,98)=3.51$, $p<.004$. Univariate ANOVA

procedures showed significant main effects of group on WMS Digits Backward, $F(2,51)=10.80$, $p<.0001$, but not on WMS Mental Control, $F(2,51)=3.97$, $p<.025$ or WMS Digits Forward score, $F(2,51)=5.75$, $p<.006$. Follow-up mean contrasts showed that Genuine subjects produced significantly higher scores on the Digits Backwards test than either the Malingering or Head Injury groups, which were not significantly different from each other.

Immediate verbal free recall. A MANOVA performed on the set of variables representing immediate free recall of verbal material was highly significant, Wilk's Lambda $F(8,96)=5.73$, $p<.0001$. Univariate ANOVA procedures showed significant main effects of group on WMS Logical Memory score, $F(2,51)=13.81$, $p<.0001$, CVLT Trial 1, $F(2,51)=11.76$, $p<.0001$, and CVLT Trial 5, $F(2,51)=10.48$, $p<.0001$. Follow-up mean contrasts showed that Genuine subjects produced significantly higher scores than either Malingering or Head Injury groups on all three of these measures. The performance of the Malingering and Head Injury groups was not significantly different on all three indices.

Immediate verbal cued recall. A MANOVA performed on the set of variables representing immediate cued recall of verbal material was highly significant, Wilk's Lambda $F(6,98)=6.23$, $p<.0001$. Univariate ANOVA procedures showed significant main effects for group on WMS "Easy" Paired Associates, $F(2,51)=9.88$, $p<.0002$, WMS "Hard" Paired Associates, $F(2,51)=16.52$, $p<.0001$, and CVLT Short Delay Cued Recall, $F(2,51)=17.66$,

$p<.0001$. Follow-up mean contrasts showed that Genuine subjects produced significantly higher scores than either Malingering or Head Injury groups on all measures of immediate cued recall of verbal material. The performance of the Malingering and Head Injury groups was not significantly different on any of these indices.

Delayed verbal free recall. A MANOVA performed on the set of variables representing delayed and unstructured free recall of verbal material was highly significant, Wilk's Lambda $F(4,100)=14.23$, $p<.0001$. Univariate ANOVA procedures showed significant main effects for group on WMS Delayed Logical Memory, $F(2,51)=27.14$, $p<.0001$, and CVLT Long Delay Free Recall, $F(2,51)=33.08$, $p<.0001$. Follow-up mean contrasts showed that Genuine subjects produced significantly higher scores than either Malingering or Head Injury groups on both measures of this component of memory functioning. The performance of the Malingering and Head Injury groups was not significantly different on either index.

Delayed verbal cued recall. A MANOVA performed on the set of variables representing delayed cued recall of verbal material was highly significant, Wilk's Lambda $F(4,100)=11.18$, $p<.0001$. Univariate ANOVA procedures showed significant main effects for group on CVLT Long Delay Cued Recall, $F(2,51)=19.16$, $p<.0001$. Follow-up mean contrasts showed that Genuine subjects produced significantly higher scores than either Malingering or Head Injury groups on this measure of delayed cued recall of verbal material.

The performance of the Malingering and Head Injury groups was not significantly different on this index.

Immediate nonverbal free reproduction. A MANOVA performed on the set of variables representing the immediate reproduction of nonverbal material, Wilk's Lambda $F(4,100)=5.09$, $p<.0009$. Univariate ANOVA procedures showed significant main effects for group on WMS Visual Reproduction, $F(2,51)=11.07$, $p<.0001$, but not for the ROCF immediate memory trial, $F(2,51)=3.61$, $p<.03$. Follow-up mean contrasts showed that Genuine subjects produced significantly higher scores than either Malingering or Head Injury groups on more simple Visual Reproduction subtest. The performance of the Malingering and Head Injury groups was not significantly different on this index.

Delayed nonverbal free reproduction. A MANOVA performed on the set of variables representing the delayed reproduction of nonverbal material was highly significant, Wilk's Lambda $F(4,100)=7.47$, $p<.0001$. Univariate ANOVA procedures showed significant main effects for group on WMS Delayed Visual Reproduction subtest, $F(2,51)=16.49$, $p<.0001$, and ROCF delayed memory trial, $F(2,51)=7.07$, $p<.002$. Follow-up mean contrasts showed that all three groups differed significantly from each other with respect to performance on Delayed Visual Reproduction. Genuine subjects performed higher than Head Injury subjects, while Malingering subjects performed significantly lower than both comparison groups. The performance of Genuine and Head Injury groups on the ROCF delayed reproduction trial was not significantly different.

Malingering subjects demonstrated significantly lower performance than the Genuine group but not the Head Injury group.

Qualitative variables

Whereas some variables represent the quantitative output of a subject's memory capacity, other indices have been developed which describe more qualitative aspects of memory behavior. Ten variables comprised the variable set representing qualitative aspects of memory functioning. Univariate ANOVA alpha levels for these comparisons were corrected to provide Type I error protection, yielding an alpha level of .005 as the criterion necessary to obtain statistical significance (alpha of .05/10 comparisons=.005). Table 6 presents several qualitative memory constructs, the clinical memory variables which measure them, and MANOVA results. Table 7 presents the results of univariate ANOVAs and follow-up mean contrasts.

Forgetting. Scores representing the amount of information which was forgotten over delay intervals were computed for WMS Logical Memory and Visual Reproduction subjects as well as the ROCF memory trials. These scores were computed as the delayed memory score divided by the immediate memory score, multiplied by 100, and therefore take into account the amount of information that was originally learned. A MANOVA performed on this variable set was highly significant, Wilk's Lambda $F(6,98)=6.28$, $p<.0001$. Univariate ANOVA procedures showed significant main effects for group on the WMS Logical Memory Percent Forget score, $F(2,52)=8.40$, $p<.0007$, and the

Table 4
Multivariate Group Differences on Quantitative Clinical Memory Variables

Memory Process	Wilk's Lambda	Variable
Composite, Overall Memory Functions	12.26***	WMS Memory Quotient CVLT Total from Trials 1-5
Attention and Concentration	3.50**	WMS Mental Control subtest WMS Digits Forward WMS Digits Backward
Immediate Free Recall of Verbal Material	5.73***	WMS Immed. Logical Memory CVLT Trial 1 CVLT Trial 5
Immediate Cued Recall of Verbal Material	6.23***	WMS "Easy" Paired Associates WMS "Hard" Paired Associates CVLT Short Delay Cued Recall
Delayed Free Recall of Verbal Material	14.23***	WMS Delayed Logical Memory CVLT Long Delay Free Recall
Delayed Cued Recall of Verbal Material	11.18***	CVLT Long Delay Cued Recall CVLT Recognition Hits
Immediate Reproduction of Nonverbal Material	5.09**	WMS Immed. Visual Reprod. ROCF Immed. Reproduction.
Delayed Reproduciton of Nonverbal Material	7.47***	WMS Delayed Visual Reprod. ROCF Delayed Reproduction

* $p<.05$ ** $p<.01$ *** $p<.001$

Table 5
Univariate Group Differences on Quantitative Clinical Memory Variables

Variable	Group		
	Genuine	Malinger	Head Injury
WMS Memory Quotient			
Mean	116.1[A]	82.4[B]	85.8[B]
SD	13.2	15.1	17.4
F(2,52) = 26.89***			
CVLT Total Trials 1-5			
Mean	59.2[A]	40.4[B]	35.7[B]
SD	7.5	12.5	15.0
F(2,52) = 17.13***			
WMS Mental Control			
Mean	7.3[A]	6.5[A,B]	5.3[B]
SD	1.8	2.8	1.9
F(2,52) = 3.97*			
WMS Digits Forward			
Mean	7.3[A]	6.1[B]	5.8[B]
SD	0.7	2.0	1.2
F(2,52) = 5.75**			
WMS Digits Backward			
Mean	5.8[A]	4.3[B]	3.9[B]
SD	1.2	1.5	1.0
F(2,52) = 10.80***			
WMS Immed. Log. Mem.			
Mean	12.5[A]	7.1[B]	7.0[B]
SD	3.5	2.4	4.4
F(2,52) = 13.82***			

* $p<.05$ ** $p<.01$ *** $p<.001$
Note. All data are raw scores. Means with different superscripts differ significantly at $p<.05$.

Table 5--continued
Univariate Group Differences on Quantitative Clinical Memory Variables

Variable	Group		
	Genuine	Malinger	Head Injury
CVLT Trial 1			
Mean	8.4[A]	5.1[B]	5.0[B]
SD	2.2	1.8	2.9
F(2,52) = 11.76***			
CVLT Trial 5			
Mean	13.6[A]	9.9[B]	8.7[B]
SD	1.9	3.5	3.8
F(2,52) = 10.48**			
WMS "Easy" Assoc.			
Mean	17.7[A]	15.7[B]	15.3[B]
SD	0.5	2.2	1.7
F(2,52) = 9.88**			
WMS "Hard" Assoc.			
Mean	9.7[A]	5.7[B]	4.3[B]
SD	1.9	3.2	3.1
F(2,52) = 16.52***			
CVLT SD Cued Recall			
Mean	13.6[A]	8.6[B]	7.3[B]
SD	1.7	3.7	3.6
F(2,52) = 17.66***			

* $p<.05$ ** $p<.01$ *** $p<.001$
Note. All data are raw scores. Means with different superscripts differ significantly at $p<.05$.

Table 5--continued
Univariate Group Differences on Quantitative Clinical Memory Variables

Variable	Group		
	Genuine	Malinger	Head Injury
WMS Delayed Log. Mem.			
Mean	12.0[A]	4.9[B]	5.1[B]
SD	3.2	2.7	3.9
F(2,52) = 27.14***			
CVLT LD Free Recall			
Mean	13.6[A]	5.3[B]	6.1[B]
SD	1.9	3.5	4.6
F(2,52) = 33.08***			
CVLT LD Cued Recall			
Mean	13.9[A]	7.5[B]	6.7[B]
SD	1.7	4.2	4.5
F(2,52) = 19.16***			
WMS Immed. Vis. Reprod.			
Mean	12.2[A]	7.5[B]	9.1[B]
SD	1.7	3.7	3.9
F(2,52) = 11.07***			
ROCF Immed. Reprod.			
Mean	19.2[A]	13.7[A]	14.0[A]
SD	7.8	6.0	6.0
F(2,52) = 3.61*			

* p<.05 ** p<.01 *** p<.001
Note. All data are raw scores. Means with different superscripts differ significantly at p<.05.

Table 5--continued
Univariate Group Differences on Quantitative Clinical Memory Variables

Variable	Group		
	Genuine	Malinger	Head Injury
WMS Delayed Vis. Reprod.			
Mean	9.9[A]	3.3[C]	6.4[B]
SD	3.0	2.7	4.1
F(2,52) = 16.49***			
ROCF Delayed Reprod.			
Mean	19.0[A]	11.3[B]	13.6[A,B]
SD	7.3	5.5	6.3
F(2,52) = 7.07**			

* p<.05 ** p<.01 *** p<.001

Note. Means with different superscripts differ significantly at p<.05.

WMS Visual Reproduction Percent Forget score, $F(2,52)=12.16$, $p<.0001$, but not the ROCF Percent Forget score, $F(2,52)=4.30$, $p<.02$.

Follow-up mean contrasts showed that Malingering subjects produced significantly higher forgetting scores on the WMS Logical Memory and Visual Reproduction subtests than either Genuine or Head Injury groups. The performance of the Genuine and Head Injury groups was not significantly different on these two indices.

Recognition memory. Variables derived from the CVLT Recognition list provided a good opportunity to evaluate group differences in variables generated from a signal detection framework. A MANOVA performed on this variable set was highly significant, Wilk's lambda $F(8,96)=4.92$, $p<.0001$. Univariate ANOVA procedures showed significant main effects of Group on d-Prime, $F(2,52)=13.64$, $p<.0001$, and False Alarms, $F(2,52)=7.16$, $p<.002$, but not on Response Bias, $F(2,52)=0.25$, $p<.78$. Follow-up mean contrasts revealed that the Genuine group demonstrated superior discriminability and fewer false positive errors than either the Malingering or Head Injury group. The Malingering and Head Injury groups did not differ significantly with respect to these recognition indices. The groups did not differ significantly on their tendency to favor "yes" or "no" responses irrespective of the stimulus type.

ROCF qualitative scoring. Performance on the Rey-Osterrieth Complex Figure provided an excellent opportunity to analyze qualitative aspects of memory performance. The copy, immediate reproduction, and delayed

Table 6
Multivariate Group Differences on Qualitative Clinical Memory Variables

Memory Process	Wilk's Lambda	Variable
Rate of Forgetting	6.28***	WMS LM Percent Forget WMS VR Percent Forget ROCF Percent Forget
Recognition Memory	4.92***	CVLT Recognition Hits CVLT Recognition False Alarms CVLT D-Prime CVLT Response Bias

* p<.05 ** p<.01 *** p<.001

Table 7
Univariate Group Differences on Qualitative Clinical Memory Variables

Variable	Group		
	Genuine	Malinger	Head Injury
LM Percent Forget			
Mean	3.3[B]	34.4[A]	31.3[B]
SD	10.4	22.4	40.9
F(2,52) = 8.40***			
VR Percent Forget			
Mean	18.7[B]	63.8[A]	35.4[B]
SD	22.5	31.6	33.4
F(2,52) = 12.16***			
ROCF Percent Forget			
Mean	-2.6[B]	19.6[A]	5.0[A,B]
SD	27.5	24.2	24.8
F(2,52) = 4.30*			
CVLT D-Prime			
Mean	96.1[A]	78.9[B]	83.8[B]
SD	3.7	13.2	12.2
F(2,52) = 13.64***			
CVLT Response Bias			
Mean	-0.1	-0.1	0.00
SD	0.2	0.5	0.4
F(2,52) = 0.25			
CVLT Recog. False Alarms			
Mean	0.5[B]	4.6[A]	4.2[A]
SD	1.0	4.7	4.2
F(2,52) = 7.16**			

* $p<.05$ ** $p<.01$ *** $p<.001$

Note. All data are raw scores. Means with different superscripts differ significantly at $p<.05$.

reproduction of the ROCF were scored according to criteria put forth by Lezak (1983). Each of 18 different design elements were scored separately for absence (score=0), distorted/incomplete and placed poorly (score=0.5), distorted/incomplete and placed properly (score=1.0), and accurate and proper placement (score=2). Tables 8, 9, and 10 present data on the percentage of subjects in each group producing absent or distorted scores for each individual design element.

For purposes of economy, scoring elements were next divided into two groups: major configurational elements contributing to the overall gestalt of the figure and small detail elements. Following Lezak's scoring system, major configurational elements were the large rectangle (scoring unit number 2), the diagonal cross (unit 3), the horizontal and vertical midlines of unit 2 (units 4 and 5), and the large triangle connected with 2 (unit 9). The remaining scoring units were designated as small detail elements. Tables 11, 12, and 13 present mean percentages of errors committed by subjects in each group as a function of type of design element.

Hypothesis tests were performed to detect group differences on the mean percentage of errors for each type of design element for the copy trial of the ROCF. This was repeated for the immediate and delayed reproductions as well. Given 36 paired comparisons, a significance level of .001 was used as the criterion for obtaining a statistically significant difference (alpha of .05/36 comparisons=.0014). No pairwise comparisons reached significance.

However, certain trends in the data were evident. Malingering subjects tended to omit more design elements in the copy trial than the other groups. Malingering and Head Injury subjects tended to produce a similar percentage of omissions and distortions, higher than Genuine subjects. The omission of design elements, especially details, rather than distortions lowered the overall scores in the immediate and delayed memory trials for both the Malingering and Head Injury subjects.

Summary. Genuine subjects clearly demonstrated intact and above average memory abilities, as reflected in their scores on composite measures of general memory functioning. As compared to Genuine subjects, Head Injury subjects demonstrated clinically significant impairment in attention, concentration, and recent memory abilities. On average, the performance of Head Injury subjects fell approximately 2.3 standard deviations below that of the Genuine subjects. Table 14 presents average effect sizes computed from this study. From a quantitative perspective, Malingering subjects produced scores which were remarkably similar to Head Injury subjects. Malingering subjects typically performed much worse than Genuine subjects, but at a level which was not significantly different, from the bona-fide memory impairment of the Head Injury subjects. On average, the performance of Malingering subjects fell approximately 2.2 standard deviations below that of the Genuine subjects. Malingering subjects generally scored slightly higher than Head Injury subjects on tasks measuring attention and concentration, immediate recall and cued

recall of verbal material, and delayed cued recall of verbal material. Malingering subjects scored lower than Head Injury subjects on tasks measuring delayed recall of verbal and nonverbal material. Only one test, the WMS Delayed Visual Reproduction subtest, showed sufficient discriminatory power to separate all three groups. Malingering subjects over-exaggerated their impairment on this test, producing a grossly impaired score of 3.3, almost half that of the Head Injury group.

From a qualitative perspective, Malingering subjects demonstrated an exaggerated amount of forgetting on the WMS Logical Memory and Visual Reproduction subtests (defined as the loss of originally-learned information over delay intervals). By and large, however, Malingering subjects successfully portrayed the qualitative aspects of bona-fide memory impairment. This includes the Malingering group's ability to accurately balance the omission of behavior with the commission of incorrect behavior to produce responses similar to bona-fide memory impairment.

Experimental Memory Tasks

Word stem completion

Main task analysis. Each subject in the present study served as his own control in that chance or baseline performance on the stem completion task was determined by the percentage of distractor (new) words completed in the target direction. Baseline performance for the three groups (Genuine=14%; Malingering=14%; and Head Injury=8.7%) was not significantly different,

Table 8
Performance on the Copy of the Rey-Osterreith Complex Figure

Unit	Omission Errors Absent (score=0)			Comission Errors Distorted (.5/1)		
	G	M	HI	G	M	HI
1. Cross, UL	0	5	15	60	80	62
2. Lg rectangle	0	10	0	25	35	54
3. Diag. cross	0	15	0	20	25	38
4. Horz. ML of 2	0	15	8	5	10	31
5. Vert. ML of 2	0	15	0	35	30	23
6. Sm. rect. in 2	0	5	8	40	60	62
7. Sm. sg. ab. 6	0	35	15	5	0	8
8. 4 lines in 2	0	10	8	20	30	38
9. Triangle, 2	0	10	0	25	50	31
10. Sm. VL in 2	0	20	8	20	5	15
11. Circle, 3 dots	0	0	8	10	25	15
12. 5 par. lines,	0	5	0	10	50	23
13. Triangle on 2	0	5	0	20	35	39
14. Diamond, 13	0	15	8	5	15	31
15. Vert. In., 13	5	5	15	25	50	38
16. Horz. In., 13	0	10	8	10	15	15
17. Cross, LC	0	10	0	15	45	62
18. Square on 2	0	0	0	25	30	39

Note. Column subheadings are abbreviated as follows: G=Genuine, M=Malingering, and HI=Head Injury. All data are percentages of each subject group obtaining the indexed score for the indexed scoring unit.

Table 9
Performance on the Immediate Reprod. of the Rey-Osterreith Complex Figure

Unit	Omission Errors Absent (score=0)			Comission Errors Distorted (.5/1)		
	G	M	HI	G	M	HI
1. Cross, UL	25	20	8	60	75	92
2. Lg rectangle	0	0	0	35	55	58
3. Diag. cross	20	55	42	15	5	25
4. Horz. ML of 2	5	35	33	15	5	25
5. Vert. ML of 2	5	40	25	20	10	25
6. Sm. rect. in 2	40	35	42	30	60	50
7. Sm. sg. ab. 6	60	80	83	5	0	0
8. 4 lines in 2	15	30	58	45	55	34
9. Triangle, 2	60	75	67	20	20	33
10. Sm. VL in 2	85	100	92	0	0	8
11. Circle, 3 dots	10	10	25	25	35	59
12. 5 par. lines, 3	30	55	42	20	30	17
13. Triangle on 2	15	15	8	25	25	33
14. Diamond on 13	15	40	33	25	20	17
15. Vert. ln. in 13	75	80	75	15	15	17
16. Horz. ln. in 13	30	40	42	15	0	0
17. Cross, LC	15	25	33	80	75	67
18. Square on 2	25	40	33	60	60	67

Note. Column subheadings are abbreviated as follows: G=Genuine, M=Malingering, and HI=Head Injury. All data are percentages of each subject group obtaining the indexed score for the indexed scoring unit.

Table 10
Performance on the Delayed Reprod. of the Rey-Osterreith Complex Figure

Unit	Omission Errors Absent (score=0)			Comission Errors Distorted (.5/1)		
	G	M	HI	G	M	HI
1. Cross, UL	15	40	8	85	60	92
2. Lg rectangle	0	5	8	45	45	42
3. Diag. cross	30	50	42	20	15	33
4. Horz. ML of 2	0	35	25	15	5	17
5. Vert. ML of 2	5	45	25	20	10	17
6. Sm. rect. in 2	40	50	42	35	45	50
7. Sm. sg. ab. 6	60	95	83	0	5	0
8. 4 lines in 2	15	45	75	55	35	25
9. Triangle, 2	60	90	67	20	5	25
10. Sm. VL in 2	90	95	92	0	5	0
11. Circle, 3 dots	10	35	33	35	40	25
12. 5 par. lines, 3	20	65	33	30	30	33
13. Triangle on 2	15	15	33	15	30	8
14. Diamond on 13	10	45	33	25	15	17
15. Vert. ln. in 13	60	85	75	25	10	17
16. Horz. ln. in 13	35	50	50	5	10	0
17. Cross, LC	20	40	33	75	60	67
18. Square on 2	25	65	42	65	35	58

Note. Column subheadings are abbreviated as follows: G=Genuine, M=Malingering, and HI=Head Injury. All data are percentages of each subject group obtaining the indexed score for the indexed scoring unit.

Table 11
Performance on the Copy of the Rey-Osterreith Complex Figure

	Absent (score=0)			Distorted (.5/1)		
Unit	G	M	HI	G	M	HI
Configurational Elements	0^{A}	12^{A}	3^{A}	19^{B}	25^{B}	33^{B}
Detail Elements	0^{C}	10^{C}	7^{C}	22^{D}	37^{D}	35^{D}

Table 12
Performance on the Immed. Reprod. of the Rey-Osterreith Complex Figure

	Absent (score=0)			Distorted (.5/1)		
Unit	G	M	HI	G	M	HI
Configurational Elements	12^{E}	31^{E}	25^{E}	21^{F}	17^{F}	28^{F}
Detail Elements	38^{G}	49^{G}	49^{G}	32^{H}	37^{H}	38^{H}

Table 13
Performance on the Delayed. Reprod. of the Rey-Osterreith Complex Figure

	Absent (score=0)			Distorted (.5/1)		
Unit	G	M	HI	G	M	HI
Configurational Elements	14^{I}	33^{I}	31^{I}	20^{J}	16^{J}	17^{J}
Detail Elements	35^{K}	63^{K}	51^{K}	38^{L}	29^{L}	34^{L}

Note. Column subheadings are abbreviated as follows: G=Genuine, M=Malingering, and HI=Head Injury. All data are percentages of each subject group obtaining the indexed score for the indexed scoring unit. Means within each scoring category and element type with different superscripts differ significantly at $p<.05$.

Table 14
Average Observed Effect Sizes

Type of Task	Malingerers vs. Normals	Head Injured vs. Normals	Malingerers vs. Head Injured
Clinical Memory Tests	-2.2	-2.3	+0.1
Implicit Memory Tests Only	-0.5	-0.3	-0.3
All Experimental Memory Tests	-1.4	-0.9	-0.4
Overall Average	-1.4	-1.2	-0.2

$F(2,52)=1.27$, $p<.29$, and was equivalent to baseline rates reported in the literature (Graf, Squire, & Mandler, 1984) which average approximately 11 percent. Collapsed across groups, the main effect of word status (target versus distractor) was highly significant, $F(1,52)=80.49$, $p<.0001$.

Within-group analyses of variance revealed that all three experimental groups demonstrated priming on the word stem completion task. Figure 5 presents this data. The main effect of word status (target versus distractor) was significant for the Genuine group, $F(1,19)=67.29$, $p<.0001$, the Malingering group, $F(1,19)=22.79$, $p<.0002$, and the Head Injury group, $F(1,14)=39.88$, $p<.0001$. Follow-up mean comparisons confirmed that word stems were completed in the target direction significantly more often when the word was previously exposed compared to the unexposed condition for all three groups. The interaction between group and target status was significant, $F(2,52)=9.00$, $p<.0004$. Follow-up analyses indicated that Genuine subjects demonstrated significantly more priming on WSC than either the Malingering or Head Injury groups.

Collapsed across groups, the main effect of orienting task was nonsignificant, $F(1,52)=1.75$, $p<.19$. The interaction between group and orienting task was also nonsignificant, $F(2,52)=.03$, $p<.97$. Computed within group, the main effect of orienting task was nonsignificant for the Genuine group, $F(1,19)=.17$, $p<.69$, the Malingering group, $F(1,19)=.17$, $p<.69$, and the Head Injury group, $F(1,14)=.26$, $p<.62$. Figure 5 presents this data. All three

groups showed a slight trend towards higher percent correct stem completion of target words encoded in the physical orienting condition.

An alternative analytic approach involved computing a binary variable which reflected whether or not each subject demonstrated priming on stem completion. For each subject, baseline performance for that subject was subtracted from target performance, resulting in a variable which reflected the magnitude of priming. Using a very conservative cutoff of a 25% increase in performance of targets over distractors, each subject was categorized as to whether his stem completion performance reflected priming or no priming. Fourteen of 20 Genuine subjects (70%) demonstrated priming, compared to 9 of 20 Malingering subjects (45%) and 11 of 15 Head Injury subjects (73%). Nonparametric hypothesis tests for the significance of difference between proportions failed to reach significance ($Z=-.48$, $p<.32$). The Malingering group's lower frequency of priming approached but barely failed to reach significance ($Z=-1.55$, $p<.055$).

Yes/no recognition following stem completion. One important question concerns the degree to which subjects employ explicit memory processes while performing nominally implicit memory tasks. The word stem completion task would seem especially vulnerable to contamination by explicit memory. After completing stem completion itself, subjects answered "yes" or "no" beside each generated word to indicate whether they recognized this word from the study list. Three aspects of this task were scored. First, the probability of correct

recognition was conditionalized upon the probability of correct word completion. This was operationalized as the percentage of correctly completed target stems which were correctly recognized as having been studied [denoted as P(WS+|REC+)]. Second, the probability of answering "yes" to an incorrectly completed target stem was computed [denoted as P(WS-|REC+)]. Third, the probability of answering "yes" to a distractor target stem was computed [denoted as P(DIST|REC+)].

This data is presented in Figure 6. Between-group comparisons were carried out on these three probability estimates. The results revealed no significant main effects of group on the conditional probability of correct explicit recognition, $F(2,52)=0.63$, $p<.59$, the probability of responding "yes" to an incorrect target word, $F(2,52)=.63$, $p<.59$, and the probability of responding "yes" to a distractor word, $F(2,52)=1.85$, $p<.30$.

Trial-by-trial analysis. Another indirect approach to assess the effect of explicit memory processes involved evaluating subject's completion accuracy as they proceeded through the list of stems. A subject could potentially alter his completion performance to the extent that he develops awareness during an implicit task that study items were previously encountered during the study phase of the experiment. In the present context, Genuine subjects could use explicit memory for the study words in completing the stems (i.e., they could use stems as recall cues). A Malingering subject's situation is more complicated, but he could potentially withhold correct completion based on

explicit memory of a target word after "catching on" to the memorial aspects of the task. The change in a subject's response strategy or criterion was operationalized as changes in percent accuracy for successive groups of target stems as serial position increases. Here, serial position refers to position on the test list rather than the study list. The target stems were divided into groups of 2 words, representing partitions of 20% of the overall list. Figure 6 presents this data.

Main effects of serial order were analyzed within groups. Within-group analyses failed to reveal main effects of serial position of blocks of target words for all three groups (all F's < 1). Thus, no group demonstrated real evidence of changing response strategies or criteria as they proceeded through the stem completion task.

Awareness and intentionality. Subjects were asked several open-ended questions during the debriefing interview concerning their performance on WSC. Subjects were classified as to whether they experienced test awareness or not, and whether they consciously employed their explicit memory for test words to either facilitate or suppress their stem completion performance. Test awareness was a necessary condition for explicit mediation in all subject groups. Therefore, subjects could be classified into one of three categories: (1) those who did not experience test awareness during WSC; (2) those who did experience test awareness but who did not experience explicit memory during WSC; and (3) those who both experienced test awareness and judged

that their performance was impacted by explicit memory (for Malingering subjects, this means that they engaged in postretrieval suppression. For notational purposes, this score will be referred to as test awareness.

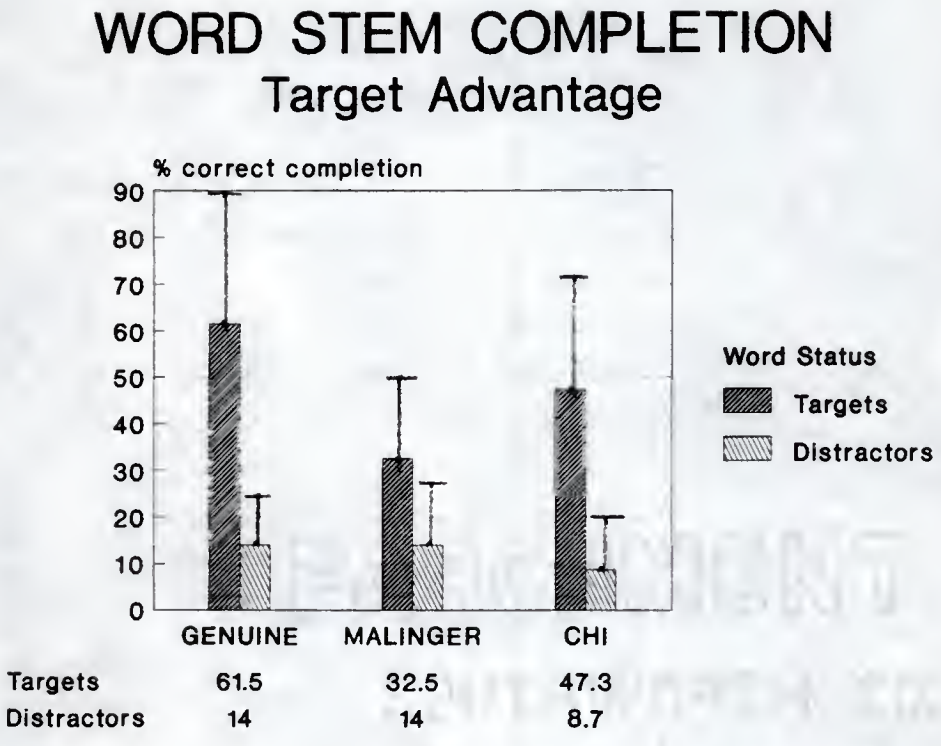
Table 15 presents data concerning the relationship between group membership, test awareness, magnitude of priming on WSC, and LOP effects. A chi-square analysis failed to detect a relationship between group membership and test awareness (X^2=4.91, df=4). However, only one Malingering subject failed to develop awareness during WSC, compared with 4 of the Genuine subjects and 5 of the Head Injury subjects.

Because test awareness was not an independent variable that was experimentally manipulated in the design, these data were examined with a nonparametric test for the comparison of two proportions. Main effects of Group on strength of priming on WSC were analyzed within level of test awareness. No significant main effects of Group were found for the Not Aware condition or the Test Aware/No Explicit Mediation condition (all Z's < 1). A different data pattern was noted in the Test Aware/Explicit Mediation condition. In this condition, Genuine subjects demonstrated a significantly greater strength of priming on WSC (mean target advantage=68%) than Malingering subjects (mean target advantage=18%), Z=-2.43, p<.007. The difference between the Malingering subjects and the Head Injury subjects approached but failed to reach significance, Z=-1.34, p<.09. The Genuine and Head Injury groups did not differ significantly, Z < 1.

No significant LOP effects were noted within these conditions, although there appeared to be a relationship between increased awareness and the use of explicit retrieval and greater completion of physically encoded words in all three groups, a highly unexpected trend.

Perceptual identification

Main task analysis. Each subject in the present study served as his own control in that chance or baseline performance on the perceptual identification task was determined by the percentage of distractor (new) words correctly identified. Baseline performance for the three groups (Genuine=25.5%; Malinger=18.2%; and Head Injury=23.1%) was not significantly different, $F(2,52)=1.16$, $p<.32$, and was equivalent to baseline rates reported in the literature (Jacoby & Dallas, 1981). Collapsed across groups, the main effect of word status (target versus distractor) was significant, $F(1,52)=94.1$, $p<.0001$. Computed within groups, the main effect of word status was significant for the Genuine group, $F(1,19)=14.44$, $p<.001$, the Malingering group, $F(1,19)=8.71$, $p<.008$, and the Head Injury group, $F(1,14)=10.69$, $p<.006$, suggesting that all three groups demonstrated priming on PI. Follow-up mean comparisons confirmed that word stems were completed in the target direction significantly more often when the word was previously exposed compared to the unexposed condition for all three groups. Figure 7 presents this data. The interaction between group and target status was nonsignificant, $F(2,52)=.31$,



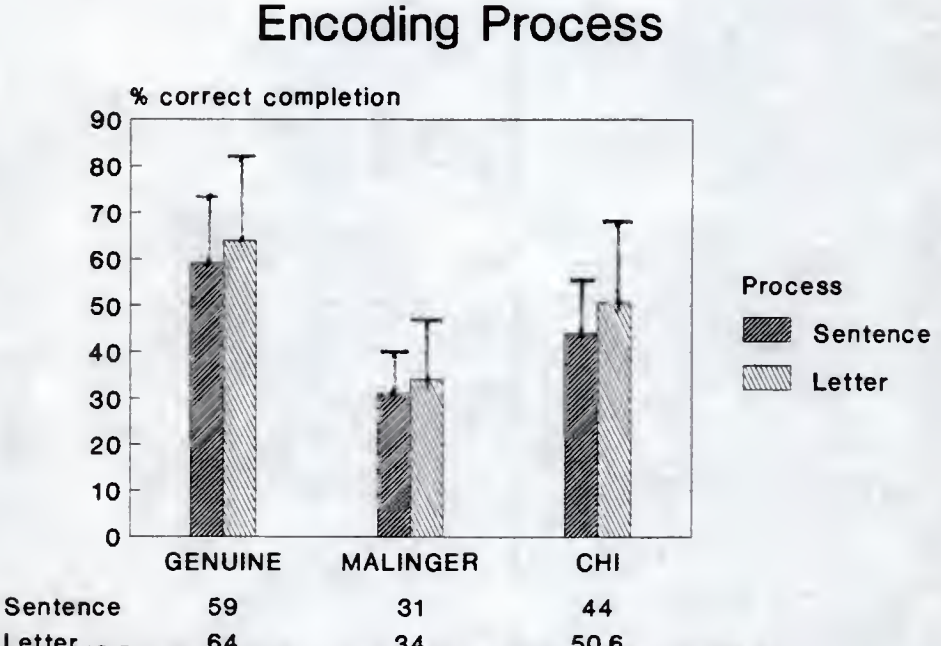
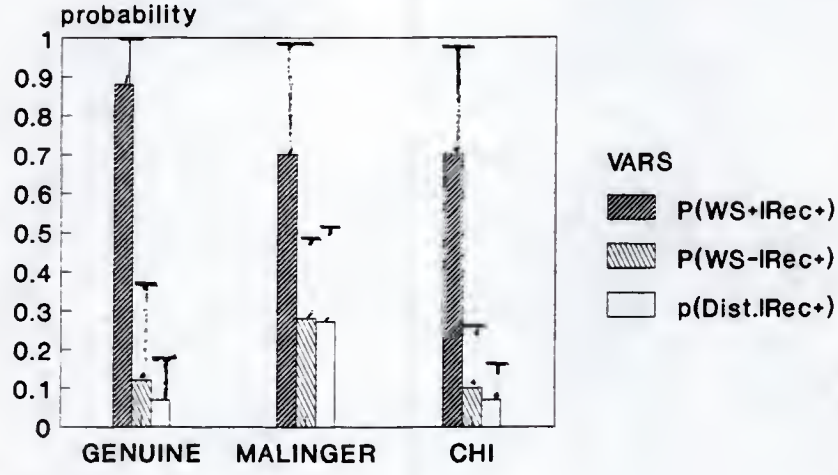


Figure 5. WSC Performance: Priming and Encoding Effects.

WSC RECOGNITION
Conditional Probabilities



	GENUINE	MALINGER	CHI
P(WS+IRec+)	0.88	0.7	0.7
P(WS-IRec+)	0.12	0.28	0.1
p(Dist.IRec+)	0.07	0.27	0.07

WSC SERIAL POSITION

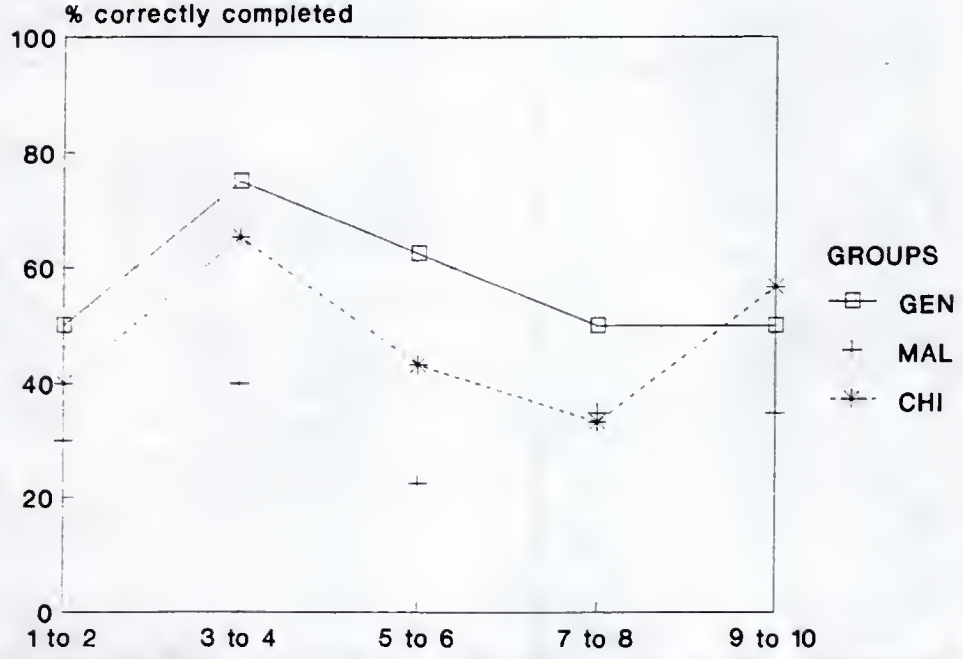


Figure 6. WSC Performance: Serial Position and Conditionalized Recognition.

Table 15
Test Awareness and Retrieval Intentionality in Word Stem Completion

	% of Group	Priming	Levels of Processing Sen.	Let.
Not Aware				
Genuine	20	+23[A]	50	30
Malinger	5	+10[A]	0	40
Head Injury	33	+34[A]	36	48
Aware but No Explicit Mediation				
Genuine	25	+22[A]	36	40
Malinger	35	+20[A]	37	31
Head Injury	27	+30[A]	45	45
Aware and Explicit Mediation				
Genuine	55	+68[A]	72	87
Malinger	60	+18[B]	30	35
Head Injury	40	+48[A,B]	50	57

Note. Within level of test awareness, means with different superscripts differ significantly at $p<.05$.

$p<.74$, indicating that all three groups demonstrated an equivalent perceptual identification advantage for previously exposed words.

Collapsed across groups, the main effect of orienting task was nonsignificant, $\underline{F}(1,52)=1.05$, $p<.31$. The interaction between group and orienting task was also nonsignificant, $\underline{F}(2,52)=.03$, $p<.97$. All three groups showed a slight trend towards higher percent correct identification of target words encoded in the physical orienting condition.

An alternative analytic approach involved computing a binary variable which reflected whether or not each subject demonstrated priming on stem completion. For each subject, baseline performance for that subject was subtracted from target performance, resulting in a variable which reflected the magnitude of priming. Using a very conservative cutoff of a 25% increase in performance of targets over distractors, each subject was scored as to whether his stem completion performance reflected priming or no priming. Nine of 20 Genuine subjects (45%) demonstrated priming, compared to 8 of 20 Malingering subjects (40%) and 8 of 15 Head Injury subjects (53.3%). Nonparametric hypothesis tests for the significance of difference between proportions failed to reach significance, indicating equivalent numbers of subjects demonstrated priming in each group.

Reaction time. The reaction time component of the perceptual identification paradigm served as one indicator of possible response strategies and criteria employed by subjects in each of the three groups. Specifically,

Malingering subjects might be expected to produce increased response latencies to the extent they were explicitly recognizing target words and then withholding the correct response. This was evaluated in several ways. Comparing main effects of word status on response latency relates generally to the processes underlying perceptual identification. Collapsed across groups, the main effect of word status on reaction time was nonsignificant, $F(1,52)=1.93$, $p<.17$. The interaction between group and word status was also nonsignificant ($F < 1$). Figure 8 presents this data.

One way Malingering subjects could have lowered their accuracy rate was by producing incorrect answers. An inhibitory process could be inferred to the extent that incorrect answers were produced by Malingering subjects at the expense of exaggerated response latencies. The main effect of answer status (correct versus incorrect) on reaction time was analyzed within each group. Figure 8 presents this data. Collapsed across groups, the main effect of answer status on reaction time was highly significant, $F(1,52)=21.28$, $p<.0001$. The interaction between group and answer status was significant, $F(2,52)=4.56$, $p<.007$. Analyzed within group, the main effect of answer status on reaction time was significant for the Genuine group, $F(1,19)=12.14$, $p<.001$, the Malingering group, $F(1,19)=7.57$, $p<.009$ and the Head Injury group, $F(1,14)=4.40$, $p<.046$. Follow-up mean contrasts demonstrated that all three groups responded significantly faster when their answer was correct as compared to incorrect responses, with Genuine subjects demonstrating a

greater difference in response latency between correct versus incorrect answers.

The previous results have shown that perceptual identification of physically encoded words shows slight but nonsignificant superiority to identification of conceptually encoded words. While Malingering subjects failed to significantly lower their accuracy rate by responding with fewer physically encoded words, trends towards explicitly driven suppression (i.e., "thinking about it") may be evident in reaction time differences between words encoded semantically versus physically in the Malingering group. Figure 9 presents this data. Collapsed across groups, the main effect of orienting task on reaction time was nonsignificant ($F < 1$). The interaction between group and orienting task was also nonsignificant ($F < 1$). All three groups showed a trend towards increased response latencies for target words relative to distractor words. A very subtle but interesting trend was evident in the data. Genuine and Head Injury subjects showed slightly faster response latencies for physically encoded words relative to conceptually encoded words, in line with the increased ability to accurately identify these words. In contrast, the Malingering subjects showed the opposite pattern of slightly higher response latencies for physically encoded words. One possible explanation for this would be that Malingering subjects experienced normal facilitation of identification of physically encoded words but then engaged in an explicitly driven suppression before responding.

Yes/no recognition following identification. The degree to which subjects employ explicit memory processes while performing nominally implicit memory tasks could also potentially affect PI performance. However, this particular task would seem much more immune to contamination from explicit memory due to the task demands of rapid reporting of near-threshold stimuli. Subjects were given a list of the same 40 words used in the PI test phase (20 targets, 20 distractors) and instructed to answer "yes" or "no" beside each stimulus word to indicate whether they recognized this word from the study portion. The task demands placed on subjects were different than those of the recognition test following WSC in that subjects did not have visual access to their responses during the test phase of PI. Two aspects of this task were scored. First, the probability of correct recognition was conditionalized upon the probability of correct identification in the test phase of PI. This was operationalized as the percentage of correctly identified target words which were correctly explicitly recognized as having been studied [denoted as P(PI+|REC+)]. Second, the probability of answering "yes" to an incorrectly identified target word was computed [denoted as P(WS-|REC+)].

Between-group comparisons were carried out on these two probability estimates. Figure 10 presents this data. The results were nonsignificant for main effects of group on the conditional probability of correct explicit recognition and the probability of responding "yes" to a non-identified target word (F's < 1).

The interaction between group and type of recognition (simple versus conditionalized) on accuracy rate was nonsignificant, ($F < 1$). Within-groups analyses of variance resulted in nonsignificant main effects of type of recognition (simple versus conditionalized) on accuracy rates for all three groups (all F's < 1). These results establish that simple recognition memory following PI was statistically independent from recognition memory conditionalized upon correct perceptual identification in all three groups. This suggests that explicit memory contributed very little to performance on PI.

Trial-by-trial analysis. A subject could potentially alter his PI performance to the extent that he or she develops awareness during PI that target words have been previously encountered in the study phase. On the surface, it would appear that PI would be much more immune to the effects of explicit memory than the stem completion task. Similarly, it would appear that deviations in responding based on explicit memory would be easily detectable by changes in reaction times. However, PI is much less generative than WSC and therefore requires only relatively automatic reading from the subject. The withholding or inhibition of behavior in general would be sufficient for Malingering subjects to lower their accuracy rate. The change in a subject's response strategy or response criterion was operationalized as a reduction in percent accuracy that occurs over several successive groups of target words. The target words were divided into groups of 4 words, representing partitions of 20% of the overall list.

Figure 10 presents this data. Main effects of serial order on identification accuracy were analyzed within groups. Within-group analyses were nonsignificant for the main effects of serial position of blocks of target words for the Genuine group, $F(4,18)=.75$, $p<.57$, the Malingering group, $F(4,18)=.39$, $p<.81$, and the Head Injury group, $F(4,13)=.72$, $p<.60$. Thus, no group demonstrated real evidence of changing response strategies or criteria as they proceeded through the PI task.

Awareness and intentionality. Aspects of awareness were categorized for PI performance in the same manner as for PI performance. Test awareness was a necessary condition for explicit mediation in all subject groups. Therefore, subjects were classified into one of three categories: (1) those who did not experience test awareness during PI; (2) those who did experience test awareness but who did not experience explicit memory during WSC; and (3) those who both experienced test awareness and judged that their performance was impacted by explicit memory (for Malingering subjects, this means that they engaged in postretrieval suppression.

Table 16 presents data concerning the relationship between group membership, test awareness, magnitude of priming on PI, and LOP effects. A chi-square analysis detected a significant relationship between group membership and the awareness variable ($X^2=13.75$, $p<.008$, $df=4$). Nine Malingering subjects reported engaging in explicit mediation (suppression)

during PI, as compared with one each from the Genuine and Head Injury groups.

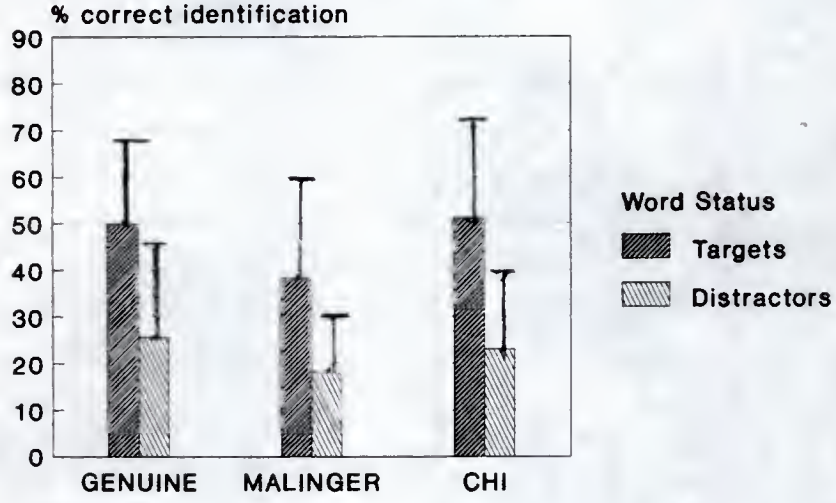
Because test awareness was not an independent variable that was experimentally manipulated in the design, these data were examined with a nonparametric test for the comparison of two proportions. Main effects of Group on strength of priming on PI were analyzed within each level of test awareness. No significant main effects of Group were found for any of the three levels of test awareness (all Z's < 1). While it appears that Malingering subjects demonstrated weaker priming than Genuine subjects in the Test Aware/Explicit Mediation condition, the small sample sizes in these cells mitigated against detecting a significant difference. All three subjects groups demonstrated priming in all three test awareness conditions. No significant LOP effects were noted within these groups, although there appeared to be a relationship between increased awareness and explicit retrieval and greater completion of physically encoded words in the Genuine and Head Injury groups.

Free recall

In contrast to the indirect memory tasks, a free recall task was employed to assess subject's explicit memory. Figure 11 presents this data. A between-groups ANOVA revealed the main effect of group on free recall performance was highly significant, $F(2,52)=28.08$, $p<.0001$. Follow-up mean contrasts revealed that Genuine subjects demonstrated significantly higher free recall

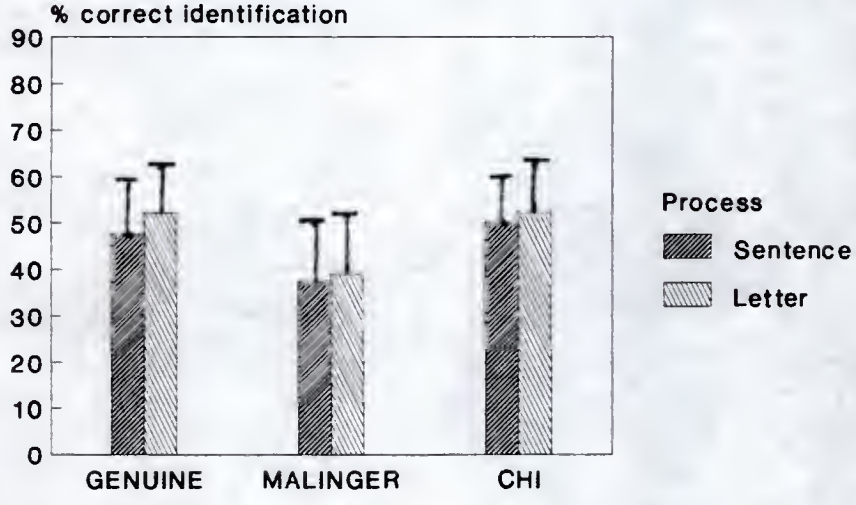
PERCEPT. IDENTIFICATION

Target Advantage



	GENUINE	MALINGER	CHI
Targets	49.8	38.2	51.2
Distractors	25.5	18.2	23.1

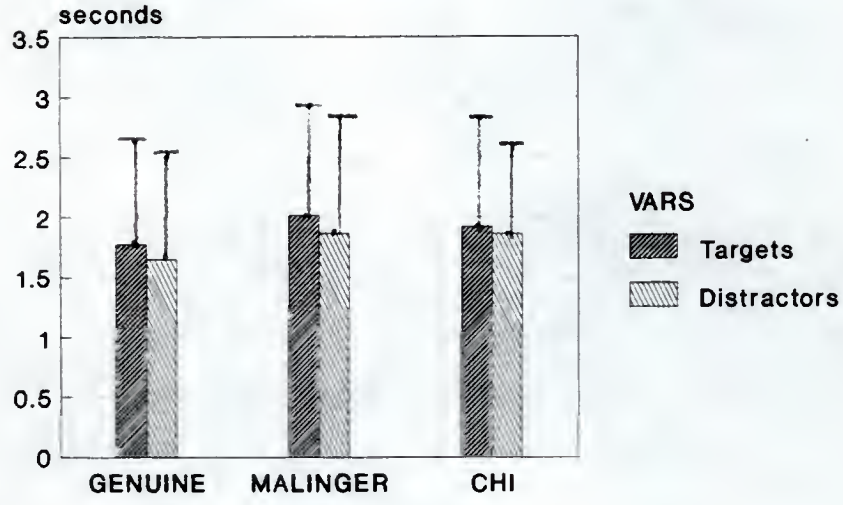
Encoding Process



	GENUINE	MALINGER	CHI
Sentence	47.6	37.4	50
Letter	52.2	39	52.4

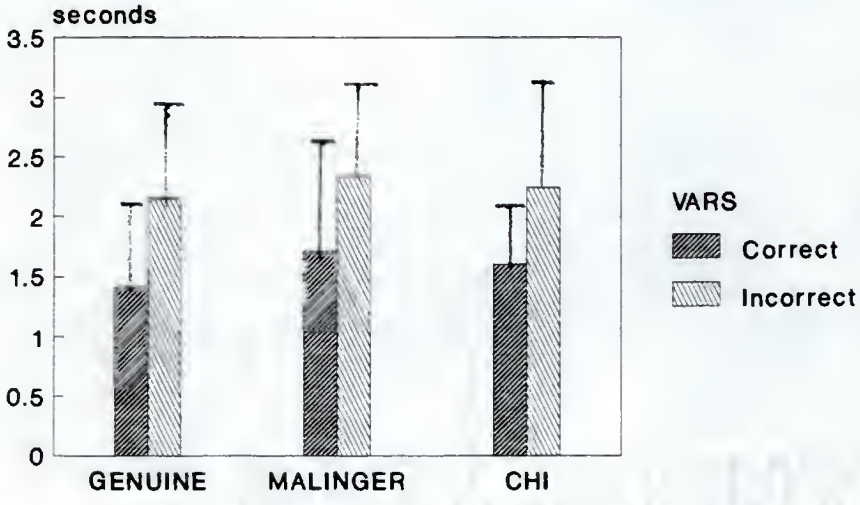
Figure 7. PI Performance: Priming and Encoding Effects.

P.I. REACTION TIME
Word Status



	GENUINE	MALINGER	CHI
Targets	1.776	2.019	1.92
Distractors	1.648	1.868	1.861

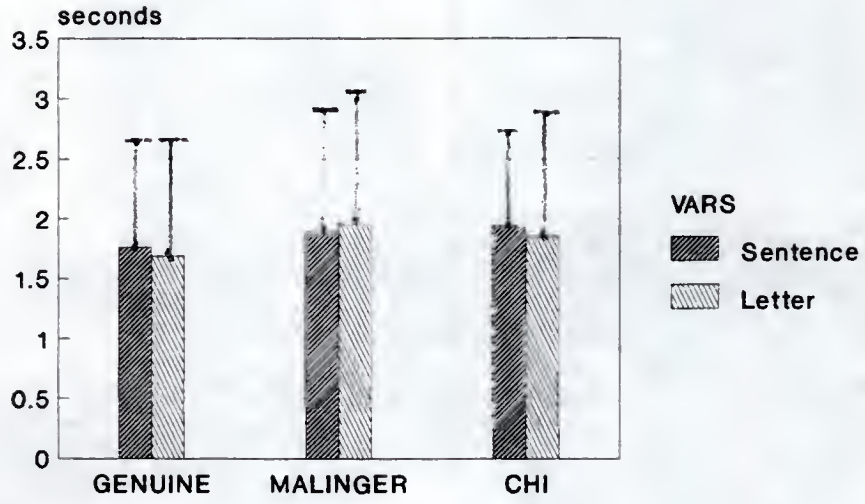
Answer Status for Target Words



	GENUINE	MALINGER	CHI
Correct	1.407	1.702	1.602
Incorrect	2.145	2.335	2.238

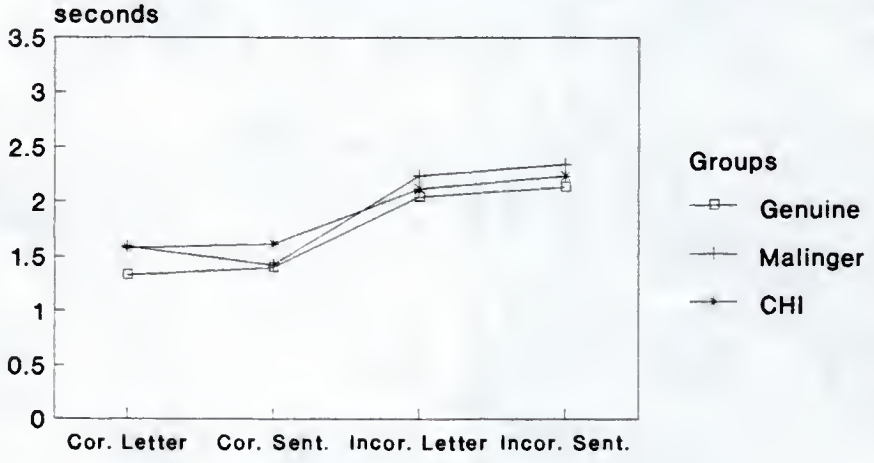
Figure 8. PI Reaction Time Data: Word Status and Answer Status.

P.I. REACTION TIME
Encoding Process



	GENUINE	MALINGER	CHI
Sentence	1.765	1.88	1.938
Letter	1.686	1.956	1.847

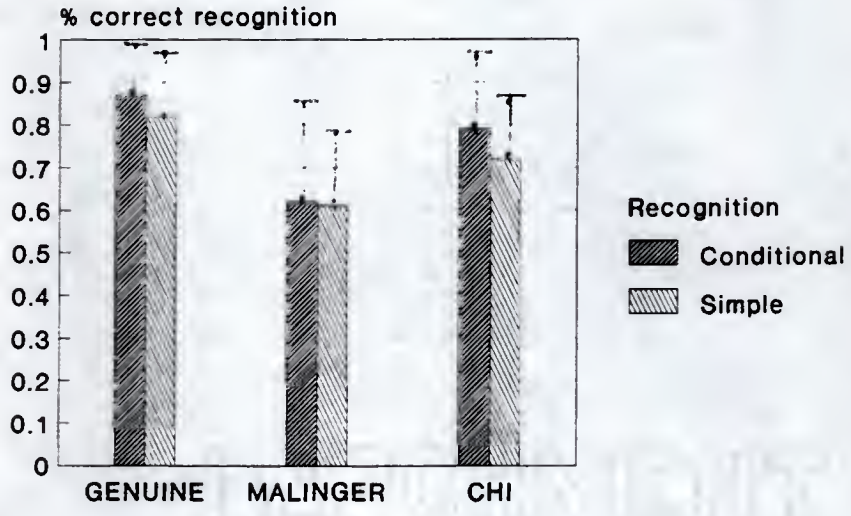
Processing by Answer Interaction



	Cor. Letter	Cor. Sent.	Incor. Letter	Incor. Sent.
Genuine	1.327	1.397	2.043	2.131
Malinger	1.588	1.421	2.232	2.338
CHI	1.578	1.612	2.116	2.236

Figure 9. PI Reaction Time Data: Encoding Process Effects.

PERCEP. IDENTIFICATION
Conditional Probabilities



	GENUINE	MALINGER	CHI
Conditional	0.87	0.62	0.79
Simple	0.82	0.61	0.72

PI Serial Position

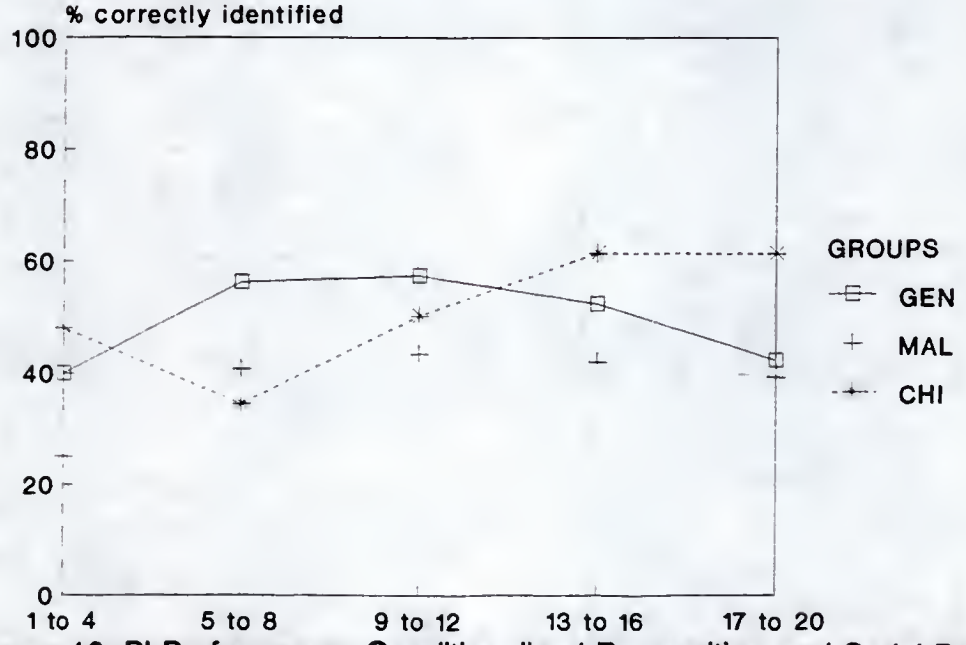


Figure 10. PI Performance: Conditionalized Recognition and Serial Position

Table 16
Test Awareness and Retrieval Intentionality in Perceptual Identification

	% of Group	Priming	Levels of Processing Sen.	Let.
Not Aware				
Genuine	65	+21[A]	46	48
Malinger	30	+13[A]	36	33
Head Injury	73	+28[A]	51	51
Aware but No Explicit Mediation				
Genuine	30	+30[A]	50	62
Malinger	25	+33[A]	56	54
Head Injury	20	+32[A]	53	67
Aware and Explicit Mediation				
Genuine	5	+40[A]	50	50
Malinger	45	+18[A]	28	34
Head Injury	7	+20[A]	30	20

Note. Within level of test awareness, means with different superscripts differ significantly at $p<.05$.

(mean=35%) than either the Malingering (mean=15.5%) or Head Injury groups (mean=10.3%), which were not significantly different from each other.

Within-group analyses of variance showed the main effect of orienting task was highly significant for the Genuine group, $F(1,19)=24.21$, $p<.0001$, the Malingering group, $F(1,19)=33.62$, $p<.0001$, and the Head Injury group, $F(1,19)=8.65$, $p<.01$. Figure 11 presents this data. Follow-up mean contrast tests established that all experimental groups recalled significantly more words encoded in the conceptual orienting condition than words encoded in the physical orienting condition. The interaction between group and orienting task approached but failed to reach significance, $F(2,52)=2.70$, $p<.08$.

Multiple choice recognition

Main task analysis. Multiple choice recognition was employed as another indirect memory test. Figure 12 presents this data. A between-groups ANOVA revealed the main effect of group on multiple choice recognition was highly significant, $F(2,52)=18.39$, $p<.0001$. Follow-up mean contrasts revealed that genuine subjects demonstrated significantly higher explicit memory (mean=93.8%) as measured by recognition of previously presented words than either the Malingering (mean=62.5%) or Head Injury groups (mean=70.7%), which were not significantly different from the other.

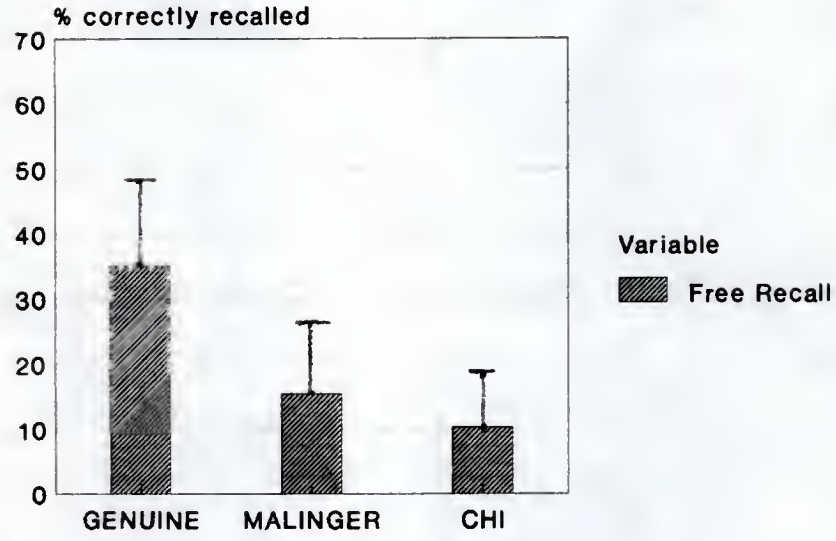
Within-group analyses of variance showed the main effect of orienting task was nonsignificant for the Genuine group, $F(1,19)=1.43$, $p<.25$, the Malingering group, $F(1,19)2.70$, $p<.12$, and the Head Injury group,

$F(1,19)=4.28$, $p<.06$. The interaction between group and orienting task failed to reach significance, $F(2,52)=.82$, $p<.44$. Figure 12 presents this data. The failure of subjects in each group to demonstrate the expected advantage for conceptually encoded words is consistent with other reports in the literature of an absence of orienting task effects in recognition paradigms (see Bradshaw & Anderson, 1982). The task demands of this task were not difficult, permitting subjects to accurately recognize words encoded in the physical condition.

Trial-by-trial analysis. A Malingering subject could potentially suppress his multiple choice recognition performance to the extent that he perceived that he is "over-responding" or portraying memory ability of insufficient impairment, not understanding the undemanding task requirements of MCR. The change in a subject's response strategy or criterion was operationalized as changes in percent correct recognition for successive blocks of test words. The stimuli were divided into groups of 4 words, representing partitions of 20% of the overall list.

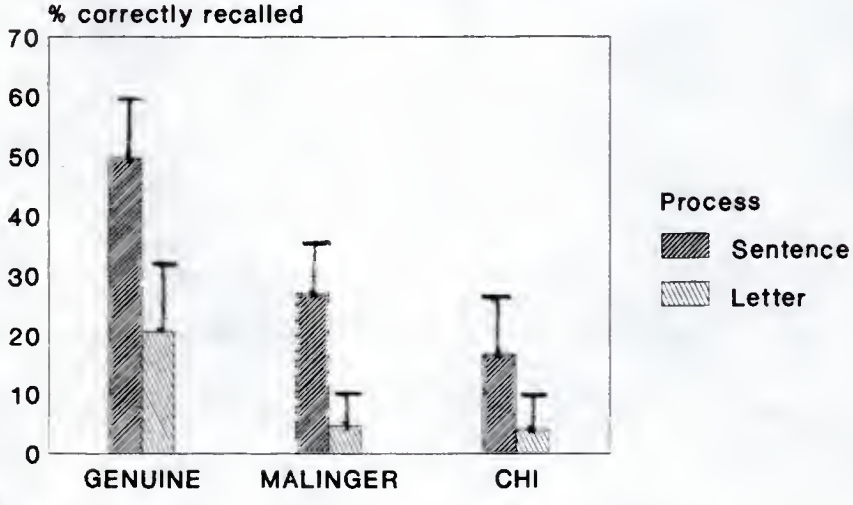
Figure 13 presents this data. Main effects of serial order were analyzed within groups. Within-group analyses were nonsignificant for main effects of serial position of blocks of target words for the Genuine group, $F(4,18)=1.68$, $p<.16$, or the Malingering group, $F(4,18)=2.66$, $p<.039$. A significant main effect of serial order was found for the Head Injury group, $F(4,13)=4.72$, $p<.002$. Follow-up mean contrasts revealed that Head Injury subjects recognized significantly fewer words on the last 20% of the test list than from

FREE RECALL
Overall Performance



	GENUINE	MALINGER	CHI
Free Recall	35	15.5	10.3

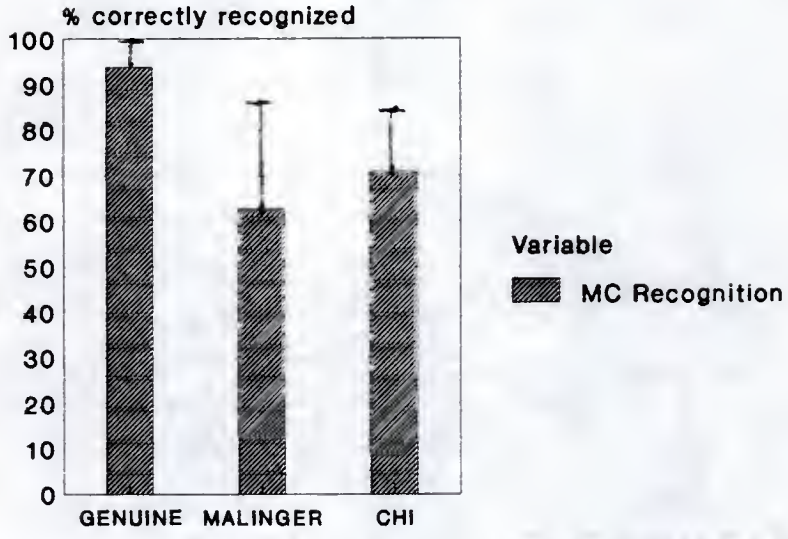
Encoding Process



	GENUINE	MALINGER	CHI
Sentence	49.6	27	16.6
Letter	20.6	4.6	4

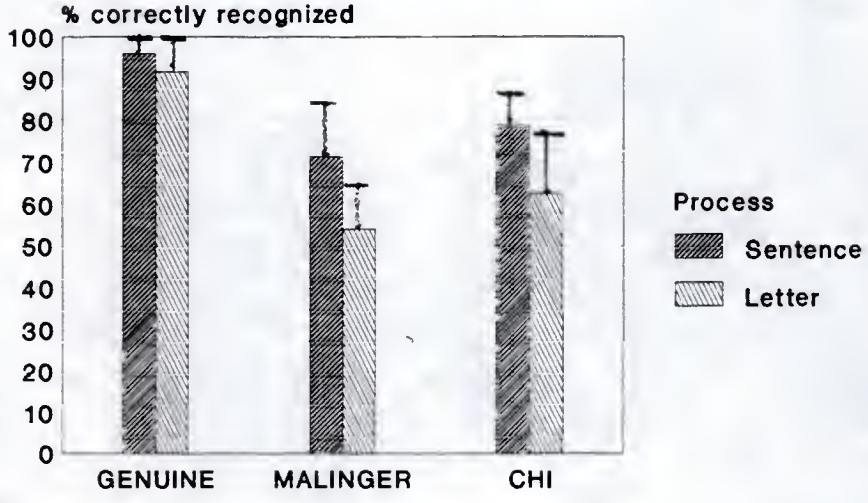
Figure 11. Free Recall: Overall Performance and Encoding Effects.

MC RECOGNITION
Overall Performance



	GENUINE	MALINGER	CHI
MC Recognition	93.8	62.5	70.7

Encoding Process



	GENUINE	MALINGER	CHI
Sentence	96	71.4	78.6
Letter	91.6	54	62.6

Figure 12. MC Recognition: Overall Performance and Encoding Effects

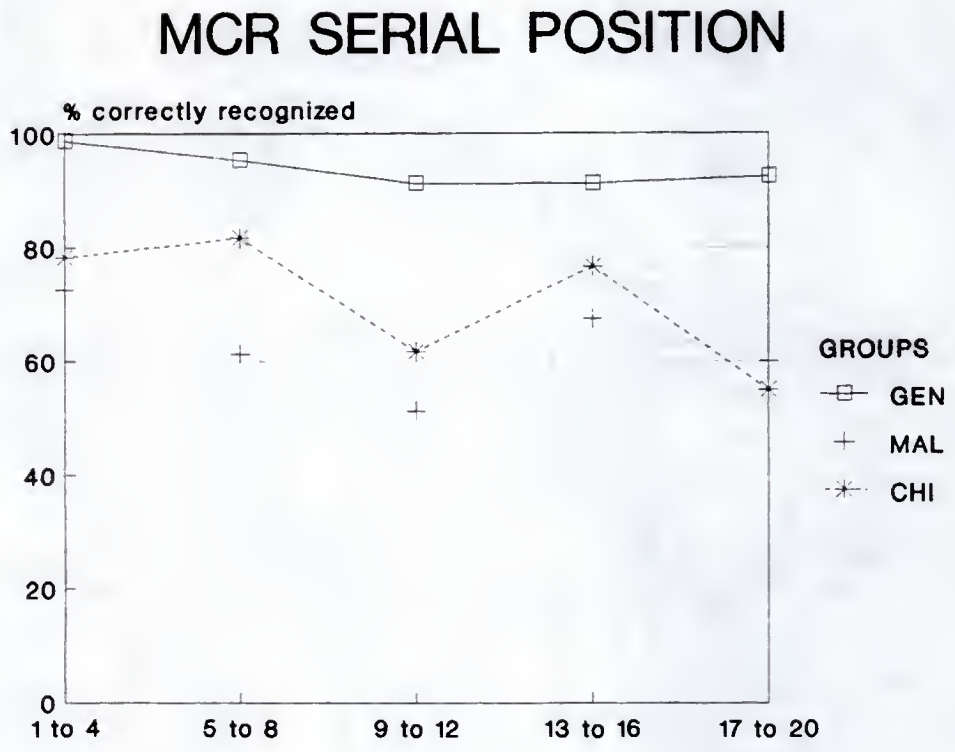


Figure 13. MC Recognition: Serial Position Effects.

the second 20%. No other blocks of words were significantly different. This finding may reflect the vulnerability of the Head Injury patients to increasing levels of interference as the task proceeds.

Symptom Validity Testing

Two components of the Symptom Validity Testing paradigm were analyzed. First, the subject's number of correct responses over the 100 trials (expressed as percent correct) were subjected to between-groups analyses of variance. Second, reaction time data was analyzed between-groups. Characteristics of the performance of the Malingering group were analyzed in more fine detail.

Between-groups analyses

Response accuracy. A between-groups analysis of variance resulted in a highly significant main effect of group upon SVT accuracy rate, $F(3,60)=17.23$, $p<.0001$. Follow-up mean contrasts revealed that the Malingering group scored significantly lower (mean=81.6% correct) than either the Genuine (mean=100% correct), the Head Injury group (mean=98.7% correct), or the Amnesic group (mean=99.8%), which were not significantly different from one another. Table 16 presents the response accuracy data.

Response latency. The response latency to forced choice testing could potentially be sensitive to a malingering response style in that Malingering subjects may generally produce slowed or exaggerated behavior while playing their role. A between-groups analysis of variance demonstrated a highly

significant main effect of group on SVT response latencies, $F(2,52)=24.42$, $p<.0001$. Follow-up mean contrasts revealed that Malingering subjects (mean=2.46 seconds) produced significantly longer response latencies to respond to items, irrespective of correctness of response, than either the Genuine (mean=0.76 seconds) or Head Injury groups (mean=1.28 seconds), which were not significantly different from one another. Table 17 presents these data. A similar analysis was conducted for correct answers only, with equivalent results. A highly significant main effect of group on response latencies for correct responses was found, $F(2,52)=25.57$, $p<.0001$. Follow-up mean contrasts produced the same ordering of means. Finally, an analysis was conducted for the main effect of group on reaction time for incorrect answers (Genuine subjects were excluded due to the absence of incorrect answers). The results were nonsignificant ($F < 1$).

As contrasted with a general process of producing slowed or exaggerated behavior, Malingering subjects may also demonstrate trends towards inhibition or suppression of correct responses during the SVT paradigm (i.e., "thinking about it"). This process could potentially be manifest as differential response latencies for correct versus incorrect answers. A within-group analysis was performed on the Malingering group only. The main effect of answer status on response latency was nonsignificant ($F < 1$), but response latency was slightly slower for incorrect answers.

Characteristics of malingering performance

The Malingering subjects' performance on SVT is unexpected given what has previously been reported in the literature. Pankratz and his colleagues (Pankratz, 1983; Pankratz, Fausti, & Peed, 1975) designed SVT to function as a clinical tool. One requirement necessary for SVT to be useful in this context is that the results of SVT can be applied on an individual-subject basis. In order to fulfill this requirement, the absolute criterion of random or chance performance is used as the comparison value. Principles of binomial probability theory are used to determine the probability associated with a particular subject's performance. The criterion of random or chance performance provides strong and convincing, though not irrefutable, evidence that a subject is exaggerating impairment. However, a careful examination of the results presented here provides a strong indication that the criterion of chance performance may be too rigorous and may result in insensitivity to malingering response styles.

Table 18 presents SVT data for all Malingering subjects. A score of 41% accuracy (out of 100 trials) is associated with the cumulative binomial probability of .0443. Thus, a subject must obtain a score of 41% accuracy (for 100 trials) or less in order to be classified as performing significantly below chance, at the .05 alpha level. No Malingering subject scored this low; only one subject (# 34) scored below nominal chance performance (45/100, binomial probability=0.184). Only three other Malingering subjects scored near chance

levels. At the other extreme, six of 20 Malingering subjects (30%) produced perfect accuracy rates on SVT. In their debriefing interview, these subjects consistently related their perceptions that SVT was an extremely easy task and that producing even a few incorrect answers would render their performance unbelievable. Table 19 shows quite clearly that Malingering subjects produced remarkably consistent accuracy rates as they proceeded through the task.

Relation to clinical memory tests. Symptom Validity Testing appears to be a generally easy task requiring very little effort to complete correctly. Pearson product-moment correlations were computed between the two SVT scores (accuracy rate and mean reaction time) and the major clinical memory variables. Table 20 presents this data. Both SVT accuracy rate and mean response latency were highly correlated with the clinical memory variables. These relationships were essentially equivalent when computed from just the Malingering group. Several aspects of these results bear comment. First, SVT response latency shows consistently stronger relationships with the clinical variables than the accuracy score. Second, accuracy rate on SVT bears no statistically significant relationship with response latency on SVT, suggesting that these two components may be independent. Third, the intriguing relationship between performance on SVT and the WMS Delayed Visual Reproduction is apparent from the inspection of Tables 18 and 20. As can be seen, very poor scores on Delayed Visual Reproduction are associated with lowered scores on SVT in the Malingering group.

Alternative data analysis strategies. Binomial principles can be applied to SVT data in two other ways, both illustrating the difficulty in using a random or chance level of performance as the criterion for malingering. Miller (1986) presented a case study in which a patient was suspected of producing hysterical sensory loss. This patient obtained a score of 56/120 on 2-item, forced choice testing. This score was below nominal chance performance of 60/120, but failed to reach the necessary .05 binomial significance level of 50 out of 120. In order to further understand this patient's performance, the author subdivided the total of 120 trials into 24 blocks of 5 trials each. This data is presented in Table 21. The subject could potentially produce 0 through 5 correct responses per trial block. Cross-tabulation frequency counts were then computed for the number of trial blocks in which the subject produced all possible number of correct responses (0 to 5). Finally, expected frequencies for each cell were computed. A chi-square analyses demonstrated that the subject obtained scores of 2/5 and 3/5 on a higher than expected number of trial blocks. Using this statistical procedure, Miller was able to demonstrate that his patient's performance deviated significantly below chance for a portion of the SVT procedure.

In the current dataset, one subject obtained a score of 45/100, which falls below the nominal chance level but fails to reach statistical significance. The subject only produced 1 correct response during trials 70 to 79. Refer to Table 18 for this subject's (# 34) data. Expected frequencies of each possible

score within each 10 trial block were computed based on binomial probability. When these expected score frequencies were crossed with the obtained score frequencies, a chi-square analysis on this subject's data failed to reach significance, $X^2=3.385$, df=5. This failure of statistical and probability methods to detect deviations from chance performance on a subject whose performance is clearly in question highlights the difficulty with using the chance criterion.

The standard use of the binomial distribution is to calculate probabilities and cumulative probabilities associated with chance performance. Another use of binomial probability methods could potentially increase the ability of the clinician to detect malingered or exaggerated performance. Rather than using .50 (chance) as the estimate of the true population proportion, the subject's own total score, expressed as the accuracy rate, could instead be used to as the estimate for the true population proportion. Next, the binomial distribution could be constructed for 10 block trials, resulting in the cumulative probabilities for obtaining scores of 0/10, 1/10, 2/10, etc. based on the subject's own level of overall performance.

To follow the previous example, Subject #34 obtained a score of 1/10 correct during trials 70 to 79. The cumulative binomial probability of obtaining this score, based on the estimate of the true population proportion of .45, is significant at the .05 level (p=.0236). Thus, it can be established for this subject that a portion of her SVT performance fell significantly below what would be expected given her performance over the 100 trials. It is important to

Table 17
Univariate Group Differences on Symptom Validity Testing

Variable	Group			
	Genuine	Malinger	Head Injury	Amnesic
SVT Accuracy Rate				
Mean	100[A]	81.6[B]	98.7[A]	99.8[A]
SD	0	17.9	1.9	0.44
F(3,60) = 17.23***				
SVT Mean Overall Reaction Time				
Mean	0.76[A]	2.46[B]	1.28[A]	N/A
SD	0.14	1.25	.37	
F(2,52) = 24.42***				
SVT Mean RT for Correct Responses				
Mean	0.76[A]	2.45[B]	1.26[A]	N/A
SD	0.14	1.24	0.33	
F(2,52) = 25.57***				
SVT Mean RT for Incorrect Responses				
Mean	----	2.90	2.62	N/A
SD	----	1.57	1.74	
F(1,17)=0.12				

* $p<.05$ ** $p<.01$ *** $p<.001$

Note. Means with different superscripts differ significantly at $p<.05$.

Table 18
SVT and Selected Clinical Data for Malingering Group

Subject Number	SVT %Cor	SVT RT	WMS MQ	WMS VR Delay	CVLT Total 1-5	ROCF Delay
34	45	1.85	80	0	35	2.5
36	57	2.10	57	0	31	0.5
20	58	3.87	64	1	31	10.5
12	59	3.58	59	0	44	3.5
24	62	1.70	72	1	24	9.0
28	69	1.69	87	2	60	10.5
16	74	3.77	86	6	61	18.0
9	77	2.45	73	0	36	12.5
15	82	1.50	90	0	36	15.5
33	84	5.07	53	0	14	2.0
39	86	3.87	93	3	27	11.0
23	89	1.85	93	2	39	14.0
14	90	1.48	90	6	47	12.0
27	99	4.30	80	4	44	14.5
2	100	1.73	94	4	38	15.0
5	100	2.11	87	4	36	15.5
8	100	3.52	84	1	57	8.0
18	100	0.67	103	13	40	16.5
31	100	0.59	97	10	57	19.0
38	100	1.34	106	9	51	15.0

Note. All data are raw scores.

Table 19
SVT Response Data for Malingering Group

Subject Number	SVT %Cor	Blocks of 10 Trials 1	2	3	4	5	6	7	8	9	10
34	45	7	4	3	4	5	3	1	5	5	8
36	57	5	8	8	6	4	7	5	5	5	6
20	58	7	7	7	6	5	5	6	6	4	5
12	59	6	6	5	8	6	4	6	6	6	7
24	62	5	6	5	6	6	6	7	7	8	6
28	69	7	7	8	7	7	6	7	6	6	8
16	74	10	9	8	9	7	6	5	6	7	7
9	77	9	8	8	7	10	8	8	5	6	8
15	82	10	9	9	8	8	7	7	8	8	8
33	84	9	8	10	9	9	9	8	8	7	7
39	86	10	10	9	8	8	9	9	9	7	7
23	89	9	8	9	9	9	9	9	8	9	10
14	90	10	10	9	9	10	9	8	8	8	9
27	99	10	10	10	10	9	10	10	10	10	10
2	100	10	10	10	10	10	10	10	10	10	10
5	100	10	10	10	10	10	10	10	10	10	10
8	100	10	10	10	10	10	10	10	10	10	10
18	100	10	10	10	10	10	10	10	10	10	10
31	100	10	10	10	10	10	10	10	10	10	10
38	100	10	10	10	10	10	10	10	10	10	10

Note. All data are raw scores.

Table 20
Correlations between SVT and Clinical Memory Variables

	SVT % Correct	SVT Mean Reaction Time
SVT Mean Reaction Time	-0.16	---
WMS Memory Quotient	0.53***	-0.64***
Digits Backward	0.43***	-0.67***
WMS Immed. Logical Memory	0.37**	-0.40**
WMS Delayed Logical Memory	0.44***	-0.50***
WMS Immed. Visual Reprod.	0.52***	-0.57***
WMS Delayed Visual Reprod.	0.59***	-0.62***
CVLT Total Trials 1-5	0.31*	-0.47***
CVLT Short Delay Free Recall	0.33*	-0.47***
CVLT Long Delay Free Recall	0.41**	-0.55***
CVLT Recognition Hits	0.46***	-0.39**
ROCF Immediate Reprod. Reproduction	0.45***	-0.25
ROCF Delayed Reprod.	0.48***	-0.41**

* $p<.05$ ** $p<.01$ *** $p<.001$

Table 21
SVT Analyses based on Miller (1986)

	Number of Correct Responses						
	0	1	2	3	4	5	Total
Expected	0.75	3.75	7.5	7.5	3.75	0.75	24
Observed	0	2	12	10	0	0	24

Note. The data represent the frequency of the correct responses per trial block (out of 5 total). Row data should sum to 24.

Source. Miller (1986).

note that this method fails to detect any other Malingering subject, highlighting the relative consistency from trial to trial that Malingering subjects are capable of achieving. This is one additional example of the difficulty in firmly establishing the presence of malingering or exaggeration.

Multivariate Statistical Detection of Malingering

Whereas previous statistical analyses have focused on establishing group differences on the various experimental and clinical memory tests, the current analysis addresses the overall question of whether some multivariate combination of variables is capable of making a classification between no memory impairment (Genuine group), malingered memory impairment (Malingering group), and bona-fide memory impairment (Head Injury group). Linear discriminant function analyses are routinely used to address questions related to the clinical utility of tasks in detecting group membership (i.e., diagnosis).

Experimental memory tasks

Variables comprising the set of measures of experimental memory tasks comprised two general types. The indirect memory measures included the magnitude of priming for stem completion and perceptual identification as well as the mean reaction time for correctly identified target words during PI. Measures of explicit memory included the explicit recognition probes associated with the PI and WSC tasks as well as the free recall and multiple choice recognition tasks. Two separate questions could be addressed by dividing the

variables in this manner. The first issue pertains to the ability of all of the experimental memory variables, implicit as well as explicit, to detect group membership. The second issue pertains to the ability of the three implicit memory variables, taken alone, to predict group membership.

All experimental memory variables. Table 22 presents the classification rates produced from a linear discriminant function analysis based on the entire experimental memory variable set. Overall, this variable set produced surprisingly accurate group predictions. Whereas group differences on the individual variables failed to separate the three groups, the linear combination of all tasks would appear to offer a relatively useful clinical tool. Malingering subjects were classified with the least amount of accuracy. However, the sensitivity rate of 89.4% and the specificity rate of 11% offer clinically significant improvements over chance diagnostic rates.

Genuine subjects were identified quite accurately; only one subject was classified as belonging to the Malingering group. This subject's scores on the experimental memory tasks were characterized as below average performance on implicit memory tasks and significantly below average performance on the explicit memory tasks. Head Injury subjects were identified quite accurately as well; only one subject was identified as belonging to the Genuine group. This subject's scores on the experimental memory tasks were characterized as above average performance on implicit memory tasks but performance on explicit memory tasks equivalent to that of Genuine subjects.

Malingering subjects were identified with less accuracy than subjects in the other two groups. Three subjects were classified as belonging in the Genuine group. These subjects produced scores on indirect and direct tests equivalent to the Genuine group. Only one Malingering subject was classified as belonging to the Head Injury group. This subject's scores on the experimental memory tasks were characterized as average performance on implicit memory tasks but poor performance on explicit memory tasks, equivalent to the bona-fide impairment of Head Injury subjects.

Indirect memory variables. Table 23 presents the classification rates produced from a linear discriminant function analysis based on just the implicit memory indices. Overall, implicit memory tasks failed to produce accurate group predictions. The sensitivity rate of 43.9% and the specificity rate of 56% were inadequate for clinical use. The group membership of Head Injury subjects proved especially difficult to predict; only 1 of 15 was correctly predicted. Additionally, these results confirm the hypothesis raised above that the discriminant power exhibited by the experimental memory tasks as a group was primarily the consequence of the direct rather than indirect memory tasks.

Clinical memory tasks

Within each clinical memory construct, one variable representing that aspect of memory was selected to be included in this analysis based on the highest F statistic. These variables included WMS Memory Quotient, Digits Backward, WMS Immediate and Delayed Visual Reproduction, CVLT Total of

Trials 1 to 5, CVLT Short and Long Delay Free Recall, and CVLT Short and Long Delay Cued Recall. Table 24 presents the classification rates produced from a linear discriminant function analysis based on this variable set. Overall, this variable set produced highly accurate group predictions. The sensitivity rate of 92.2% and the specificity rate of 8% offer clinically significant improvements over chance diagnostic rates.

Genuine subjects were classified with 100% accuracy. Malingering subjects were classified with 90% accuracy; only two of 20 were classified as belonging to the Head Injury group. Both of these subject's scores on the clinical tasks were characterized by (1) low but not impaired general memory functioning; (2) low but not impaired list learning; and (3) poor attention and concentration. Head Injury subjects were identified quite accurately as well; of the 20 subjects, one subject was misclassified as Genuine and one as Malingering.

Malingering subjects were identified with less accuracy than subjects in the other two groups. Three subjects were classified as belonging in the Genuine group. These subjects produced scores on clinical memory tests equivalent to the Genuine group. Only one Malingering subject was classified as belonging to the Head Injury group.

Experiential and De-Briefing Variables

Given the nature of this study, subjects in the Genuine and Malingering conditions were interviewed at length about their experiences and perceptions

Table 22
Classification Rates for Experimental Memory Tasks

Actual Group Membership	Classified into Group based on LDF		
	Genuine	Malingering	Head Injury
Genuine	95.0%	5.0%	0.0%
Malingering	15.0%	80.0%	5.0%
Head Injury	6.7%	0.0%	93.3%

Table 23
Classification Rates for Stem Completion and Perceptual Identification Tasks

Actual Group Membership	Classified into Group based on LDF		
	Genuine	Malingering	Head Injury
Genuine	60.0%	30.0%	10.0%
Malingering	25.0%	65.0%	10.0%
Head Injury	53.3%	40.0%	6.7%

Table 24
Classification Rates for Selected Clinical Memory Variables

Actual Group Membership	Classified into Group based on LDF		
	Genuine	Malingering	Head Injury
Genuine	100.0%	0.0%	0.0%
Malingering	0.0%	90.0%	10.0%
Head Injury	6.7%	6.7%	86.6%

while playing their respective roles during the experiment. Immediately after the role-playing phase of their participation, subjects were given verbal descriptions of many of the memory tasks they completed and asked to make Likert ratings concerning (1) their effort on that particular task; (2) their perceptions of the difficulty of the task (for a "normal" person with genuine motivation); and (3) and their perceived success at portraying their role (either "best effort possible" or "severe but believable impairment"). Twenty two tasks were described; each subject rated the three characteristics for each task. The form used for obtaining these ratings is presented in Appendix C. Subjects were then given a chance to discuss their perceptions and feelings about their role playing.

Debriefing ratings

The following discussion will selectively evaluate the debriefing ratings concerning several of the more important memory tasks. Table 24 presents this data. Ratings from individual tasks were averaged to obtain a mean rating of effort, task difficulty, and role-success for each subject. Analyses of variance produced highly significant main effects of group on the Effort score, $F(1,39)=18.92$, $p<.0001$, the Task Difficulty score, $F(1,39)=12.72$, $p<.0012$, and the Role-Success score, $F(1,29)=18.92$, $p<.0001$. The variance observed in these variables was highly constricted in both groups, suggesting that the experiences and perceptions were highly similar within the respective groups.

Follow-up mean contrasts revealed that Malingering subjects perceived their effort as significantly less than that perceived by Genuine subjects.

Genuine subjects perceived tasks as significantly more difficult than did Malingering subjects. Malingering subjects perceived themselves as significantly less successful in playing their role of producing "severe but believable impairment" than did Genuine subjects in achieving their best memory performance.

Both subject groups appeared to hold similar perceptions about the implicit memory tasks. Word stem completion was perceived as relatively easy by both groups. Similar effort scores supports the hypothesis that Malingerers were engaged in effortful processing that involved explicitly-mediated suppression. Genuine subjects were highly confident in their success in WSC. One interpretation is that strong explicit memory traces contributed to their self-knowledge of very high performance levels. Both groups rated PI as more difficult and effort-demanding than WSC. Similar Success scores for PI suggest the ambiguous aspects of the task make perceptions of successful and unsuccessful performance difficult for the naive subject.

Malingering subjects rated themselves as putting forth less effort than their Genuine counterparts on the SVT paradigm. Interestingly, Malingering subjects rated SVT as quite easy and undemanding. On the other hand, Genuine subjects were highly confident in their successful performance on SVT, with Malingering subjects rating themselves as less confident of the success of their role-playing.

Table 25
Debriefing Ratings for Genuine and Malingering Subjects

	Effort		Difficulty		Success	
Task	G	M	G	M	G	M
Word Stem Completion	4.53	3.65	2.93	2.24	6.00	4.29
Perceptual Identification	6.40	5.24	5.93	5.06	4.00	4.47
Symptom Validity Testing	5.07	3.65	2.60	1.18	6.87	3.71
WMS Delayed Visual Reproduction	5.73	3.94	4.60	3.59	4.87	4.41
Overall Rating Score	5.31	3.99	4.08	3.01	5.30	4.17

Note. Column subheadings are abbreviated as follows: G=Genuine and M=Malingering. The data are raw scores (on a scale from 1 to 7), averaged within group.

Responses to open-ended questions

Without exception, subjects in either the Genuine or Malingering conditions reported how difficult their roles were to play. Genuine subjects discussed the inherent difficulty of the tasks. Malingering subjects discussed the necessity to simultaneously attend to both their own bona-fide memory capabilities and their ongoing calibration of decreased performance levels. The high demand placed on Malingering subject's attention and concentration led to an interesting phenomenon. It appeared that most Malingering subject's information processing capacities became overwhelmed during some tasks, resulting in bona-fide memory problems for that task. This phenomena would be analogous to encoding stimuli under degraded or attention-divided conditions. In several subjects, this led to uncertainty and even anxiety over their perceptions of their true memory abilities. All malingering subjects reported their uncertainty over the believability of the impairment they produced.

CHAPTER 4
DISCUSSION

Validity of Group Membership

Genuine and Head Injury Subjects

The data reviewed in Chapter 3 indicate that subjects in the Genuine condition adequately invested themselves in their respective scenario and role-playing to the extent that their performance on clinical memory tests was normal. In fact, Genuine subjects demonstrated intact and even above average memory abilities as indexed by the clinical memory tests. Debriefing and interview data further establish that the participation of these subjects was adequate. The overall level of performance was relatively high, but consistent with what would be expected of these subjects based on their age, education level, and measured intelligence.

Head Injury subjects demonstrated impairment on clinical tasks requiring complex attentional processes and the learning and retention of new information. As a group, their level of performance fell in the moderate-to-significantly impaired range of scores. This group of subjects scored an average of 2.3 standard deviations below the Genuine group. Relatively equivalent performance declines were noted on verbal and nonverbal memory

tasks. Complex immediate memory functions were impaired as well as most indices of recent memory. Finally, inefficiency in all process-oriented distinctions (encoding, storage, retrieval) of memory was observed. As a group, the performance of the Head Injury subjects was clearly consistent with the moderate-to-severe nature of their injuries.

One possible criticism of this study would be that this sample of Head Injury patients was not representative of the type of patients most often seen in the medicolegal context for forensic neuropsychological evaluation. Given the need to exclude patients involved in current litigation or even considering future litigation, I would argue that there does not exist a large pool of CHI patients which would closely match litigating head injury patients. Several factors may be interacting here.

First, the definition of "compensable injury" would necessarily include the presence of an external party which could potentially be responsible for the injury. Thus, litigation status may be determined in part by the assignment of "fault", such that patients who caused their own injury are excluded from litigation while innocent victims are not excluded from litigation. Second, patients suffering an obviously severe injury which can be unequivocally documented with neurological evaluation may receive compensation or settlement of their legal claim more quickly than those patients with equivocal findings. Nevertheless, the identification and participation of these Head Injury patients was secured with great effort and expense.

To sum to this point, the Genuine subjects demonstrated above average memory abilities while the Head Injury patients demonstrated moderate-to-significant memory impairment consistent with the severity of their injuries. Given the nature of these two comparison groups, we turn our attention now to the performance of the Malingering subjects.

Performance of Malingering Subjects

Schretlen (1988), in his review of the literature on the psychometric detection of malingering, classifies studies into three levels of methodological sophistication. The present study represents the highest level of sophistication in that it includes all possible groups: experimental (Malingering subjects), criterion (Head Injury patients with bona-fide memory impairment), and control (Genuine subjects). Schretlen (1988) also discusses experimental procedures which increase experimenter control but which operate at the cost of ecological validity. He refers to these as "analog factors." Perhaps the three most important analog factors in neuropsychological malingering research are (1) the need to assess the extent to which malingering subjects actually portray their role; (2) the degree of didactic information or "coaching" provided to experimental malingerers; and (3) the desirability of providing an external incentive to these subjects which rewards successful faking.

Data from the current study suggests that subjects in the Malingering condition adequately invested themselves in their respective scenario and role-playing to the extent that their performance on clinical memory tests was

"impaired" and below that of the Genuine subjects. In terms of quantitative level of memory abilities, Malingering subjects produced scores which were remarkably similar to Head Injury subjects. Malingering subjects typically performed much worse than Genuine subjects. The average effect size associated with malingering was -2.2 standard deviations. This effect size approached the average effect size of -3.4 computed from the literature. On average, the impairment demonstrated by Malingering subjects surpassed that of the Head Injury subjects, although univariate hypothesis tests rarely detected a statistically significant difference between these two groups. Debriefing and interview data further establish that the compliance with instructional set was adequate for subjects in the Malingering condition.

Malingering subjects generally scored slightly higher than Head Injury subjects on tasks measuring attention and concentration, immediate free and cued recall of verbal material, and delayed cued recall of verbal material. Malingering subjects scored lower than Head Injury subjects on tasks measuring delayed free recall of verbal and nonverbal material. With few exceptions, Malingering subjects successfully portrayed the qualitative aspects of bona-fide memory impairment. This included the Malingering subjects' ability to accurately balance the omission of correct behavior with the commission of incorrect behavior to produce responses similar in quality to bona-fide memory impairment.

Therefore, subjects in the Genuine and Head Injury groups appeared to be representative of the larger population of subjects. Malingering subjects performed similar to those in other reported studies of experimental simulation. In general, clinical memory tests were not overwhelmingly useful in separating Malingering subjects from Head Injury patients.

As regards the external incentive for the experimental subjects, the University of Florida Introductory Psychology class required students to earn eight credits based on participation in experiments. The UF Psychology Department Subject Pool policies, however, forbade any use of performance-based incentives. This meant that subjects could not receive additional rewards beyond their participation, either in the form of extra class credit or money. However, it should be noted that this study offered subjects the opportunity to earn all but one of the credits they needed in one testing situation. Only one study has directly examined this analog factor experimentally. Bernard (1990) found no significant differences on memory performance between incentive-based and non-incentive based experimental malingerers. Schretlen (1986) provided prison inmates instructed to malinger monetary incentive to avoid detection, but no comparison group was used. Therefore, the fact that Malingering subjects were not given an additional external incentive does not appear to be a serious threat to the validity of the findings.

Several studies have provided varying degrees of didactic information and coaching to experimental malingerers (Boone, 1988; Hayward et al., 1987).

Boone (1988) found that experimental malingerers who were coached on techniques to avoid inconsistency in their performance subsequently performed with less inconsistency than non-coached malingerers. In contrast with this study, Hayward et al. (1987) asked neurological and neurosurgical nurses to feign left frontotemporal brain dysfunction on neuropsychological tests. Despite their presumably high levels of knowledge about the criterion impairment group, these nurses were unsuccessful at mimicking either the quantitative and qualitative aspects of the criterion impairment group. Little can be concluded about the issue based on these somewhat divergent findings.

The results of the current study present similar interpretive problems. On the one hand, the Malingering subjects would appear to have successfully incorporated the didactic information into their performance. On the other hand, these same subjects reported after the experiment that this information was helpful in initially formulating their role-performance but that the on-line use of this information during their role-playing was very difficult.

Experimental Memory Tasks

The main findings concerning performance on the experimental memory tests were that (1) all three groups produced similar LOP effects for direct tests in that semantically encoded words were retrieved significantly more frequently than physically encoded words; and (2) all three groups produced similar null LOP effects for indirect tests, although physically encoded words were produced with slightly more frequency than semantically encoded words. The

prediction that Malingering subjects would lower their overall level of performance on WSC did not occur. Rather, Genuine subjects used explicit memory to increase their WSC performance. This accounted for the observed differences between these two groups. No detectable changes in response strategies or response criteria were evident from analysis of WSC serial position.

The prediction that the PI task would be relatively immune to the effects of explicit memory was borne out from two perspectives. Malingering subjects failed to lower their performance with explicit memory suppression, while Genuine subjects were unable to raise their performance with explicit memory mediation. The prediction that Malingering subjects would produce increased response latencies was not accurate as well. When viewed from a clinical perspective, the performance of Malingering subjects on the experimental memory tests was indistinguishable from the memory-disordered Head Injury patients in terms of quantitative level of performance, response latency, and LOP effects.

Priming Effects

Study 1 established that the materials and procedure used in this study were valid indices of direct and indirect memory. Amnesic subjects demonstrated normal priming on word stem completion and perceptual identification in spite of severely impaired explicit memory as indexed by free recall and multiple choice recognition. Amnesic performance on indirect

memory tests was equivalent to that of a group of age and education matched control subjects.

Similarly, all three experimental groups in Study 2 demonstrated at least normal priming effects on WSC and PI. Genuine subjects produced an unexpectedly high magnitude of priming on WSC relative to any other group; this was significantly greater than that produced by the Malingering and Head Injury groups, which were not significantly different from each other. However, this data pattern did not occur for the PI task: the three groups did not differ with respect to magnitude of priming effects on PI. The present findings are generally consistent with the two published studies which have used indirect memory tests with experimental malingerers. Wiggins and Brandt (1988) found that simulators demonstrated a normal magnitude of priming on word stem completion when tested immediately after exposure to the study words. These same subjects did, however, suppress responding with target words when retested the next day. Williamsen et al., (1965) found experimental malingerers to significantly attenuate their performance on other indirect memory tests, in this case word fragment completion and free association. However, in that study, malingering subjects were directly instructed on how to enact their role.

Levels of Processing Effects

In Study 1, Amnesic patients failed to recall almost all of the study words on the FR test, consistent with their severe explicit memory impairment. Amnesic patients had so little explicit memory that their recall could not benefit

from semantic processing. Control subjects recalled approximately 17% of the words, and demonstrated significantly higher levels of recall for semantically encoded words relative to physically encoded words. The explicit memory performance of both groups improved when tested with the multiple choice recognition paradigm. Amnesic subjects recognized only 45% of the target words (compared with the 25% rate associated with chance guessing) and failed to demonstrate the LOP effect of recognition advantage for semantically encoded words. The controls recalled significantly more (78%) words in general and their recognition of semantically encoded words was significantly greater than for physically encoded words.

In Study 2, all three groups demonstrated significant LOP effects when tested on the FR paradigm in that a greater proportion of semantically encoded words were recalled relative to physically encoded words. The interaction between encoding condition and group was also nonsignificant, indicating that all three groups demonstrated equivalent LOP effects. A similar data pattern was observed for all groups when tested on the MCR paradigm. All three groups demonstrated higher levels of recognition for semantically encoded words relative to physically encoded words; however, this advantage was not statistically significant for all three groups. These results are consistent with other studies which failed to produce LOP effects on recognition paradigms (c.f., Bradshaw & Anderson, 1982). These results can be explained by the processing model, which holds that recognition memory tests usually involve a

blend of data-driven and conceptually-driven processing. Thus, subjects operate on perceptual data provided by the experimenter, but must often reconstruct the study episode in order to perform accurately (Richardson-Klavehn & Bjork, 1988).

To sum to this point, only the Amnesic subjects failed to produce LOP effects on the FR paradigm. The recognition memory of all subject groups benefitted from semantic processing, although the similarity between study and test in MCR was such that physical processing did contribute to retrieval. The defensible conclusion from this data pattern is that consistent LOP effects, favoring conceptually encoded words, were found on the direct tests of memory. Therefore, the Malingering subjects produced an equivalent pattern of performance on the direct tests, in spite of a lowered level of performance.

The LOP data from the indirect memory tests is unequivocal: all subject groups produced an equivalent proportion of conceptually and physically encoded words when tested with WSC and PI. This data is highly consistent with the other reports of null LOP effects in studies involving word stem completion (Graf & Mandler, 1982; Graf, Squire, & Mandler, 1982) and perceptual identification (Jacoby & Dallas, 1981). A relatively subtle retrieval advantage was noted for physically encoded words relative to conceptually encoded words. This finding is consistent with the predictions of the processing model (Blaxton, 1989; Roediger & Blaxton, 1987). Additionally, a similar result was obtained by Challis & Broadbeck (1992) who found null LOP

effects when processing conditions were mixed in the same study list for each subject.

Regardless of the failure to observe statistically significant transfer-appropriate processing in the indirect memory tests, this study has nevertheless demonstrated an experimental dissociation between performance on direct and indirect memory tests. I will return to discuss this matter further after consideration of possible explanations for this dissociation.

Issues Related to Meta-Memorial Experience

The consideration of the meta-memorial experiences of participating subjects warrants discussion independent of their possible effects on indirect memory test performance. In general, the experience of test awareness during WSC was frequently reported. All but one Malingering subject reported experiencing test awareness during WSC, although 80% of Genuine subjects did as well. However, this data pattern was not observed for PI: 65% of the Genuine subjects and 73% of the Head Injury patients reportedly did not experience test awareness during PI.

Given that Schacter & Bowers (1990) found that half of their sample developed test awareness during stem completion, the fact that 80% of Genuine subjects and 95% of the Malingering subjects reported developing test awareness strongly suggests that the instructional and motivational sets given to these subjects induced "meta-memorial vigilance". By this term I mean that subjects were overly vigilant and attentive for previously presented information,

resulting in an increased likelihood that the subjects would consciously make the link between the study episode and producing a target word during the indirect testing episode. Membership in either of these groups was highly conducive to the experience of test awareness on supraliminal indirect memory tests. Subliminal tests appear to provide a context which is much less conducive to the experience of test awareness with subjects who are responding genuinely. When viewed against this background, the finding that only 30% of Malingering remained test-unaware on PI suggests that it is less effortful to engage in explicitly-mediated suppression than it is to engage in explicitly-mediated facilitation. Taken further, Malingering subjects may have been directing their effort to the process of becoming test aware even on subliminal tests.

Test-awareness and retrieval intentionality appear to be partially independent and dissociable processes. In all subjects, the experience of test awareness was a condition necessary for the experience of retrieval intentionality in that no subject reported intentional retrieval without first experiencing test awareness. On the other hand, test awareness did not necessarily lead to intentional explicit retrieval. A significant proportion of each subject group reported experiencing test awareness in the absence of intentional explicit retrieval. These findings are supportive of the distinctions discussed in literature between involuntary explicit memory (i.e, test awareness) brought on as a consequence of implicit memory and intentional explicit

memory used as a basis for implicit memory (Bowers & Schacter, 1990; Richardson-Klavehn & Bjork, 1988; Schacter et al., 1989). However, it should be kept in mind that the post-testing interview method is only the subject's best guess at his mental state at the time of testing. Subject's responses could be biased by any number of factors. Further research which attempts more systematically to specify and isolate these factors is needed.

The Impact of Meta-Memorial Experiences

The experience of test awareness or absence of such experience had no appreciable effects on the observation of normal priming for all three groups on both indirect memory tests. Subjects who remained test unaware showed essentially normal priming on WSC and PI. Similarly, subjects who experienced test awareness but did not engage in intentional explicit retrieval also showed normal priming effects on WSC and PI.

However, three lines of evidence can be marshalled to suggest that postretrieval suppression (or the lack of it) impacted performance during WSC. Conversely, little evidence can be found to support the same claim for performance on PI. First, indirect evidence derives from the overall magnitude of priming observed in each group. Genuine subjects completed an unexpectedly high number of target words on WSC, which was significantly greater than the other two groups. Head Injury patients, who had relatively little explicit memory to draw upon, completed a significantly less proportion of target words on WSC than did the Genuine subjects. Malingering subjects

produced an equivalent proportion of target words on WSC as did the memory-disordered Head Injury patients, thus successfully portraying this aspect of memory impairment. The implication is that at least a portion of the Genuine subjects used explicit memory to facilitate their performance. The results from the PI task tell a different story. All three groups produced equivalent magnitude of priming on PI; analyses of response latency data robustly demonstrated no group differences across a range of comparisons.

Second, more direct evidence derives from the explicit recognition test following WSC. Genuine subjects correctly recognized 88% of their correct stem completions, compared to the 70% recognition rate for both the Malingering and Head Injury subjects. This data pattern is consistent with the interpretation that Genuine subjects may have used voluntary explicit retrieval to complete stems, that Head Injury patients had relatively little explicit memory upon which to use for intentional retrieval, and that Malingering subjects withheld correct completion for at least some stems which they explicitly remembered. Again, performance on PI presents an entirely different picture. Stochastic independence was observed in all three groups, indicating that performance on PI was functionally independent from explicit memory for the stimuli.

Finally, subjects' retrospective rating of meta-memorial experience speaks directly to this issue. No significant differences of group on magnitude of priming were detected within those subjects who reported no test awareness

or test awareness but no explict retrieval. For subjects who reported experiencing test awareness and explicit mediation, those in the Genuine and Head Injury groups demonstrated a greater magnitude of priming than those in the Malingering group. The difference between the Genuine and Malingering groups was highly significant. The difference between the Head Injury and Malingering groups approached but failed to reach significance. This suggests that some Malingering subjects were successful at withholding completion of target words which were explicitly retrieved. In contrast, PI was more resistant to the effects of explicit retrieval by virtue of the subliminal nature of testing.

The Relationship Between LOP and Meta-Memory

No consistent statistical relationship was noted between different meta-memorial experiences and levels of processing effects in any of the three groups for either WSC or PI. It was predicted that Malingering subjects could lower their level of performance on indirect tests to the extent that they used explicit retrieval and then used some form of postretrieval suppression. Malingering subjects did in fact demonstrate a lowered reporting of semantically encoded words. However, this same data pattern was observed in the other two groups. Additionally, equivalent LOP effects were observed in Malingering subjects in all awareness conditions. Given that over half the Genuine subjects clearly engaged in explicit retrieval during WSC, the fact that these subjects produced the same slight advantage for physically encoded words is quite interesting.

Two conclusions can be drawn from these data. First, implicit memory as indexed in this study by indirect perceptual memory tests does not totally exclude explicit memory from intruding upon consciousness and, in some cases, impacting performance. Although statistically significant findings supportive of the transfer-appropriate processing framework were not found in this study, the trend in the data was in the direction of slight superiority of physically encoded words. The findings that subjects who both maximize (Genuine) and minimize (Malingering) their level of performance with explicit memory indicates the strength of the processing model. This means that the physical, perceptual cues present at testing may partially override the semantic and conceptual contributions of explicit memory. Given the perceptual testing context, subjects may be able to intentionally and explicitly access target words while still retaining the benefit of the perceptual match between study and test contexts. Second, the contribution of explicit retrieval during nominally indirect tests appears to be a relatively subtle effect which failed to reach statistically significance in this study. Explicit retrieval during PI did not appear to affect the results, and it appears to operate only on a few words for a few subjects during WSC. It could be argued that limited statistical power may have resulted in a failure to detect group differences on the indirect memory tests. However, the preexperimental computation of statistical power combined with the greater effect sizes associated with the direct experimental tests (FR and MCR) would

mitigate against this argument. Rather, the contribution of explicit memory during indirect memory tests appears to be a relatively subtle effect.

Implications for the Study of Implicit-Explicit Relationships

The present study has provided new information concerning implicit-explicit memory relationships in that a subset of the Genuine subjects used explicit memory to increase their strength of priming on WSC. Malingering subjects did not, as a group, appear to engage in postretrieval response suppression because they demonstrated normal strength of priming on WSC. That is, it appears that a certain percentage of target words were completed without the use of explicit memory. On the other hand, a subset of Malingering subjects apparently experienced explicit memory for study words and elected to not report these.

Two aspects of the design of this study may have confounded the results. First, Genuine subjects did not represent an unbiased control group due to their unanticipated use of explicit memory to increase their strength of priming on WSC. The instructional set and motivational set given to these subjects (i.e., to perform to "the best of their abilities") cannot be equated with the motivational set associated with the "normal control subject" who is simply given the task-related instructions at the time of testing. Irrespective of this issue, however, Malingering subjects did not engage in postretrieval response suppression when compared to the Head Injury subjects.

Second, in this study the bias of both implicit and explicit memory was towards the facilitation of task performance. When experimental effects act in concert, performance on indirect memory tests might reflect implicit memory or explicit memory or both (Jacoby, Lindsay, & Toth, 1992). Consider a hypothetical scenario for a Malingering subject. When performing WSC, the subject completes two to three words in the target direction and immediately thereafter explicitly recognizes these words as study words. The Malingering subject does not perceive that he or she has violated the faking role by simply reporting relatively automatic behavior. Since no effortful retrieval occurred on these trials, the Malingering subject feels free to proceed with the same response criterion without undue fear of exposing their role. On some subsequent trials the Malingerer also experiences fluent completion on several stems and responds accordingly. On other trials, however, the subject may experience explicit retrieval for a target words and engage in postretrieval response suppression. The interpretive problem is that these instances of response suppression are indistinguishable for instances of bona-fide incorrect responses.

Several possible methodological manipulations would address this problem. One solution to the problem of conflation of implicit and explicit memory is the method of opposition (Jacoby et al., 1989). In this study, Jacoby and his colleagues used a fame judgement task to assess unconscious memory. The essence of this method is that subjects were informed that

whenever they explicitly remembered a previously presented name they could be sure that the name was in fact nonfamous. Any subsequent fame judgements would be the effect of unconscious memory for the study episode. This method places the effects of conscious memory in opposition to the effects of unconscious memory. All contaminating influences of conscious memory were effectively partialled out of the effects of unconscious memory.

It would be interesting to evaluate the performance of Malingering subjects using the method of opposition. In Jacoby's fame judgement paradigm, Malingering subjects would be expected to produced an increase in fame judgements to the extent that they suppressed or denied conscious memory for the previously studied names. This would place Malingering subjects in the confusing situation of producing additional behavior to represent a deficit of memory.

Another solution similar to the method of opposition would be to give subjects the paradoxical instructions "not to remember" any study words while completing the indirect memory tests. Yet another solution would be to make subjects aware of the fact that study words could potentially be used to facilitate task performace. This manipulation would make for a stronger interpretation of the data. It is predicted the Malingering subjects would demonstrate a more discrepant (impaired) performance relative to the control and criterion groups. Specifically, Malingerers would be expected to engage in postretrieval suppression more frequently than they did in this study.

Symptom Validity Testing

Whereas word stem completion and perceptual identification are classified as indirect memory tests, Symptom Validity Testing is a direct test of short-term memory. The art of SVT lies in the fact that expected performance levels are not obviously apparent to the typical subject. The performance of the Genuine and Head Injury groups provided compelling evidence that this version of the SVT task places very little demand on subject's memory capacities. The fact that Head Injury subjects with bona-fide moderate-to-severe concentration and memory impairment produced near-perfect accuracy rates further reinforces this conclusion.

The main finding concerning the SVT paradigm was that Malingering subjects, as a group, were impaired relative to other groups but scored well above chance levels. Only one subject scored below nominal chance levels, and even her score was not significantly different from chance in a probabilistic sense. Accurate responding on SVT also appears to be dissociable from performance on other clinical memory tests in Malingering subjects. While statistically significant correlations were noted, cases existed in which significant impairment was produced on clinical memory tests while SVT accuracy was well above chance. The opposite pattern was also observed.

Several other statistical methods, based on binomial probability theory, were presented to examine individual cases. Both of these methods were designed to examine the consistency of responding across the lengthy number

of trials, an ability which would at least initially appear difficult for the Malingering subject to master throughout 100 trials. Unexpectedly, Malingering subjects produced remarkably consistent accuracy rates across the 100 trials.

The method discussed by Miller (1986) breaks contiguous response trials into discrete blocks. Observed accuracy rates were compared with those expected based on binomial probability. While this method was able to document below chance performance in Miller's case study, it failed to establish below chance performance in a very similar subject in this study with an obviously questionable accuracy rate of 45% (as well as all other Malingering subjects). The other method presented involves sampling the binomial distribution using the subject's own accuracy rate as the estimate of the true population proportion. This method allows for the assignment of cumulative probabilities associated with all possible accuracy rates within blocks of trials. This method was useful in establishing that the above Malingering subject produced an accuracy rate for one block of trials which was probabilistically below what would be expected given her overall accuracy across 100 trials.

The criterion of chance performance (e.g., 50% in a 2-alternative forced-choice paradigm) was originally suggested by Pankratz and his colleagues (Pankratz et al., 1975). Data which support the criterion of chance performance derive mainly from case studies of suspected malingerers (Binder, 1990b, 1992). The data from this study, however, are consistent with other between-groups studies (Bickart et al, 1991; Wiggins & Brandt, 1988) which found only a

portion of experimental malingerers to produce below-chance performance on forced-choice testing. It could be argued that the case study approach is superior to the analogue studies on the grounds of ecological validity (see Schretlen, 1988) and that experimental malingerers are not properly motivated (i.e., compensated) to lower their SVT performance below chance levels. However, our clinical experience has encountered a heterogeneous group of litigating patients which produce accuracy rates somewhere between perfect and chance levels. To conclude, while below chance SVT performance provides the clinician with compelling evidence suggestive of malingering, these data provide equally strong evidence that deviant response sets can produce accuracy rates well above chance.

The findings concerning the reaction time component of the SVT paradigm are offered only as heuristic due to the unreliable manner of data collection. However, the findings do suggest that response latency may prove sensitive to deviant response styles. Head Injury subjects produced slower reaction times than Genuine subjects, consistent with past research (MacFlynn, Montgomery, Fenton, & Rutherford, 1984; Miller, 1970; VanZomeren & Deelman, 1978). Malingering subjects produced significantly slower response latencies than even the Head Injury patients. This data suggests that Malingering subjects over-exaggerated impairment in the form of markedly increased response latencies. Second, the correlation coefficient between SVT response accuracy and SVT response latency was -0.16. This suggests that these two

task components may be unrelated in Malingering subjects. One Malingering subject produced an accuracy rate of 100% but a mean response latency of 3.52 seconds, while another produced an accuracy rate of 45% but a mean response latency of 1.85 seconds.

Since Malingering subjects produced equivalent response latencies for correct versus incorrect answers, this would suggest that these subjects produced a more general slowing of behavior rather than slowing specific to a particular cognitive decision (i.e., ascertaining and then inhibiting a correct response). Given that differences in reaction time are often taken as evidence for the existence of separate stages of information processing (Sternberg, 1969), this finding again highlights the difficulty in characterizing the mental states of Malingering subjects. A minimum of four mental stages would be necessary to model the reaction process involved in binary classification tasks: stimulus encoding, comparison, binary decision, and response initiation (Taylor, 1973). The point to be made is that Malingering subjects could potentially fail to adequately engage in any combination of the four stages on any particular trial. Thus, within-subject differences in response latency could be obscured when performance is averaged across trials.

Debriefing ratings and interview information strongly suggests that most subjects accurately perceived two-alternative forced-choice testing as extremely easy. An interesting finding was that Malingering subjects reported perceiving SVT as easier than did Genuine subjects while they reported significantly less

confidence in their role-playing success on SVT. Additionally, Malingering subjects frequently reported that they were suspicious of the task instructions which characterized SVT as an "extremely difficult memory test." The fact that these subjects produced incorrect answers at all suggests that the nature of the instructions given to subjects may interact with the sophistication or savvy of subjects in influencing overall accuracy rate.

Given the recent proliferation of various forced-choice testing paradigms, it is especially important to caution against generalizing the results from one SVT paradigm to another. White and Rice (1991) have adapted the stimuli used in this study for use on the MacIntosh computer system. Only two minor changes were made: (1) foreground and background colors are reversed, and (2) The subject is given a maximum of 10 seconds to respond; a nonresponse in this time interval automatically results in an error score and administration of the next trial. All other timing and presentation parameters are equivalent. A validation study is in progress. The preliminary results from this adapted paradigm diverge dramatically from the present findings in that normal subjects have shown a mean accuracy rate between 85% and 95%; patients with documented brain damage score well below the levels produced by the Head Injury subjects in this study.

Several caveats concerning the clinical use of SVT are warranted as well. A below-chance performance on SVT neither proves malingering nor disproves bona-fide impairment. Similarly, suspicions of faking based on SVT

performance cannot be generalized to all of the patient's symptoms. Such performance would suggest malingering only insofar as the SVT is concerned.

However, evidence garnered from SVT would seem to justify the inference that other tests probably do not reflect the patient's true abilities (Hiscock & Hiscock, 1989). Therefore, I would argue that SVT could conceivably function in a manner similar to the F scale on the MMPI. The MMPI F scale has high intercorrelations with some clinical scales, in particular with scales 6 (paranoia) and 8 (schizophrenia). Graham (1987) states that the F scale both (1) serves as an index of test-taking attitude and is useful in detecting deviant response sets; and (2) serves as an indicator of degree of psychopathology, if profile-invalidity can be ruled out.

Clearly, SVT accuracy rate could serve as an index of test-taking attitude and response set, not as a binary variable (malingering versus not malingering) but rather as an interval variable reflecting gradations of dissimulation. This use would also be consistent with Rogers' model of malingering (1987, 1988) which holds that malingering is not a dichotomous construct but which exists on a continuum with gradations of dissimulation. Future research involving neuropsychological patient groups could proceed to validate SVT in a similar manner as was done for the MMPI (see Graham, 1987). More precise cutting scores could be derived such that scores falling below a certain level would call into question the validity of the assessment process for that patient, negating the interpretive yield of the other neuropsychological data.

Given that malingering and deviant responding can first be ruled out, the use of SVT accuracy rate and response latency as indices of neuropsychological impairment becomes straightforward. Reaction time paradigms have been shown to be robustly sensitive to brain damage (Bruhn & Parsons, 1971; Elass, 1986; Hahurin & Pirozzolo, 1986; Milner 1986) Performance on SVT will be impaired to the extent that the requisite attentional and cognitive processes necessary for normal performance are impaired. This issue, of course, highlights the important need to validate SVT paradigms on other neuropsychological patient groups.

Multivariate Detection of Malingering

The performance of the Malingering subjects has been shown to differ substantially from the Genuine subjects, even on indirect tests. However, the true task of a single test or a battery of tests designed to detect a malingering response style is to discriminate the suspected malingerer from a patient with bona-fide memory impairment. With the exception of SVT, univariate analytic techniques consistently failed to produce significant differences between the Malingering and Head Injury groups for both the clinical memory tests and the indirect experimental memory tests.

Taken as a group, however, a multivariate combination of the experimental memory tests (i.e., variables from both direct and indirect tests) produced surprisingly accurate classification rates when entered into a linear discriminant function analysis. Malingering subjects were classified with less

accuracy that the other two groups. An analysis of the incorrect classifications was suggestive of the fact that the indirect memory tests contributed very little to the classification process. A subsequent discriminant function performed just on the variables from the indirect memory tests resulted in very poor classification rates, suggesting the hypothesis that performance on indirect memory tests offers little clinical utility in itself in the detection of malingering.

A variable set was then constructed based on selected clinical memory indices and entered into a linear discriminant function analysis. The classification rates were extremely high, with a sensitivity rate of 92% and a specificity rate of 8%, averaged across the three groups. These rates were slightly more accurate than those produced by the experimental memory tests. Therefore, it appears that the experimental memory tests in general and the indirect memory tests in particular do not offer the clinician any additional information about the potential malingering patient not otherwise afforded by the routine battery of clinical memory tests. Clearly, cross-validation is needed for the discriminant equation for the clinical memory tests. It would be useful to replicate these findings on an unselected groups of litigating and nonlitigating consecutive clinic admissions with mild CHI.

The "Art" of Detecting Malingering

Perhaps the most important conclusion to draw from this study is that, with the notable exception of SVT, a single test or a "snapshot" of memory performance is insufficient to catch a Malingerer, even when the domain of such

tests is expanded to include indirect memory tests that, by their nature, seem less vulnerable to direct manipulation by subjects. This should come as no surprise because such an approach is rarely used to characterize the memory of any type of patient. The "art" of catching Malingerers appears to lie in the observance of the processes of memory as they change across difficulty levels and decay across time. While a Malingering subject may accurately portray impairment on the initial learning trials of the CVLT, he or she may have much more difficulty titrating performance when the task difficulty changes (say, for Short Delay Cued Recall). The job of malingering becomes even more ambiguous and difficult when these free recall and cued recall tasks are again tested at a 20 minute delay.

The findings concerning the WMS Visual Reproduction subtests provide an intriguing illustration of these ideas. It is well accepted that the immediate recall of the WMS figures is not an overly difficult task (Lezak, 1983). The Malingerers demonstrated a nonsignificant trend towards over-exaggeration of impairment on the immediate reproduction. However, when tested after the delay interval their performance was very low, much lower than even the Head Injury patients. When a forgetting score was computed for this task, Malingerers again over-exaggerated their impairment. In contrast, Malingerers were much more successful at calibrating their impairment on the more complex and demanding ROCF memory trials.

This data pattern would suggest that a particularly difficult situation for the Malingering subject is to be confronted with a test which allows for only a limited range of possible responses. Impairment becomes even more difficult to titrate when tested with this same task after a delay interval, when the subject presumably has a less definite objective memory trace upon which to calibrate his impairment. The more difficult, lengthy, and involved tests do not present the same challenge due to the wider range of response alternatives (and the inherent statistical variability of normal performance). It is as if the Malingering subject perceives that he or she must refrain from a certain amount of behavior irrespective of task difficulty. These omissions become more glaring on simple tasks. Finally, there is some fairly convincing evidence from the debriefing ratings which suggests that Malingerers consistently underestimate the difficulty of most memory tasks.

Summary

Normal subjects, when instructed to malinger memory impairment, significantly lowered their performance on clinical memory tests relative to similar subjects who were given instructions to perform genuinely. The qualitative aspects of malingered memory behavior were also found to be different than that produced by Genuine subjects. Moreover, Malingering subjects produced performance profiles on clinical memory tests which were highly similar to those of a sample of Head Injury patients with documented neurological damage and bona-fide neuropsychological memory impairment. In

general, no single clinical memory test or combination of several tests proved useful in diagnosing experimental malingering.

Several indirect memory tests used by cognitive psychologists were administered to these subject groups with the general idea that Malingering subjects would first experience explicit memory for study items and them engage in postretrieval suppression of correct responses. This general prediction did not hold up in that Malingering subjects produced normal strength of priming and LOP effects on both indirect memory tests. However, evidence was generated which suggested that Genuine subjects used explicit memory to increase their level of priming on word stem completion but not on perceptual identification.

In contrast to the indirect memory tests, the Symptom Validity Testing paradigm used in this study was designed as a direct test of short-term memory. The art of SVT lies in the fact that expected performance levels are not obviously apparent to the typical subject. The main finding concerning the SVT paradigm was that Malingering subjects, as a group, were impaired relative to other groups, but scored well above chance levels and demonstrated surprisingly consistent responding across trials. Several statistical methods demonstrated that the traditional criterion of chance performance may be potentially insensitive to malingering response sets.

APPENDIX A
PREEXPERIMENTAL MATERIALS

Information about Closed Head Injury

1. The medical condition known as "Closed Head Injury", abbreviated CHI, refers to damage to the head and skull area.

2. When a person sustains a CHI, they may lose consciousness for varying periods of time, often as long as several hours.

3. Immediately after sustaining a CHI, a person may not remember where they are, or what date and time it is.

4. In addition, CHI patients may not be able to remember events ocuring before the trauma. The loss of memory for events prior to the accident usually only goes back several minutes to an hour before the CHI.

5. After a CHI, a person may not be able to remember events ocuring after the injury.

6. The loss of memory for events after the accident varies depending on the severity of the injury, with more severe CHI's resulting in more loss of information.

7. After a person has recovered the ability to remember events occurring after the injury, he or she will probably still have difficulty in learning and remembering new information.

8. These learning and memory problems are very common after CHI.

9. CHI patients often have difficulty remembering words and sentences as well as geometric shapes and human faces.

10. "Short Term Memory" refers to the ability to remember small amounts of information for a few seconds. People with a CHI have a normal short term memory.

11. "Long Term Memory" refers to the ability to remember larger amounts of information for longer periods of time. People with a CHI often have difficulty with long term memory.

12. In general, the more hints and cues given to a CHI patient about what they are trying to remember, the easier it is for them to remember.

13. CHI patients usually can remember information that is presented to them at the beginning and end of an event. They have the most difficulty remembering information which is presented to them in the middle of the event.

14. CHI patients usually have the same amount of difficult remembering verbal information as they do remembering visual information.

15. CHI patients are likely to have a decrease in their intelligence.

16. In general, the more severe the CHI the more the person's intelligence decreases.

17. Approximately 50% of people having Closed Head Injuries have moderate to severe impairment in their overall intelligence.

18. Especially difficult tasks for CHI patients involve tasks which require quick and errorless peformance, paying attention for long periods of time, and making complex decisions quickly.

19. People with CHI often respond to tasks slower than they did before they had their injury.

20. CHI patients rarely have difficulty answering simple, yes/no questions about words and sentences.

Faking Scenario

The primary experimenter would like for you to play a role as you participate in this experiment. The role you are to play is based on the following scenario:

Scenario:

You have recently experienced an automobile accident about 1 month ago. This accident was not your fault; it was the other driver's fault. In this accident, you sustained a "moderate" Closed Head Injury when you hit your head on the steering wheel. You were taken to the hospital, where you received medical care. X-rays and scans were done. The results of these tests did not turn up any severe damage to your skull or brain. The doctor told you that you did not have to stay overnight in the hospital and that the doctor did not need to see you in the future for further medical treatment.

However, during the last few weeks you have been experiencing some mental problems which are very much like the problems you have just read about. You have contacted your attorney who scheduled psychological testing in order to determine if in fact your mental ability and memory have been damaged.

Your attorney tells you that if you have sustained mental injury you may be able to collect a large sum of money in damages from the driver of the other car. The more mental impairment you have, the more money you may be able to collect. However, if the psychologist, based on your test scores, reports that you were exaggerating or faking mental and memor problems, you will not be able to collect any money.

At the present time, you have arrived for your appointment for psychological testing. Your role is to fake the most severe but believable memory problems that you can on these memory tests. Your primary job is to respond to the tests as you think a person with such memory problems would. Your "acting ability" does not matter. The person who will be working with you is also playing a role of "tester". While he does not know what role you will be playing, you should not be concerned with "fooling" or "convincing" him.

Please play this role until the experimenter tells you that the experiment is over. You are to use your knowledge about Closed Head Injury which you just learned in order to play this role.

You will now be administered a brief test about your knowledge of CHI to make sure you are able to use this information when playing your role.

After this test, you will be given 5 minutes in order to play how you will play your role.

Best Effort Scenario

The primary experimenter would like for you to play a role as you participate in this experiment. The role you are to play is based on the following scenario:

Scenario:

You have recently experienced an automobile accident about 1 month ago. This accident was not your fault; it was the other driver's fault. In this accident, you sustained a "moderate" Closed Head Injury when you hit your head on the steering wheel. You were taken to the hospital, where you received medical care. X-rays and scans were done. The results of these tests did not turn up any severe damage to your skull or brain. The doctor told you that you did not have to stay overnight in the hospital and that the doctor did not need to see you in the future for further medical treatment.

However, during the last few weeks you have been experiencing some mental problems which are very much like the problems you have just read about. You have contacted your attorney who scheduled psychological testing in order to determine if in fact your mental ability and memory have been damaged.

Your attorney tells you that if you have sustained mental injury you may be unable to continue working at your lucrative job. The less mental impairment you have, the more work you can do and the more money you will be able to earn at your job. However, if the psychologist, based on your test scores, reports that you have mental and memory problems, you will no longer be able to work at your lucrative job.

At the present time, you have arrived for your appointment for psychological testing. Your role is to put forth the best effort you can, to try to perform as best as you can on these memory tests. Your primary job is to respond to the tests as you think a person with such memory problems would. Your "acting ability" does not matter. The person who will be working with you is also playing a role of "tester". While he does not know what role you will be playing, you should not be concerned with "fooling" or "convincing" him.

Please play this role until the experimenter tells you that the experiment is over. You are to use your knowledge about Closed Head Injury which you just learned in order to play this role.

You will now be administered a brief test about your knowledge of CHI to make sure you are able to use this information when playing your role.

After this test, you will be given 5 minutes in order to play how you will play your role.

Test of Knowledge about Closed Head Injury

T or F 1. Approximately 5% of people having Closed Head Injury (CHI) have moderate to severe impairment in their mental abilities.

T or F 2. CHI patients often have difficulty remembering words and sentences as well as geometric shapes and human faces.

T or F 3. CHI patients have normal short term memory abilities, so that they are able to remember small amounts of information for a brief period of time.

T or F 4. People with a CHI often have difficulty with tasks which require long term memory, so that they have difficulty in remembering larger amounts of information for a longer period of time.

T or F 5. In general, the more hints and cues given to a CHI patient about what they are trying to remember, the easier it is for them to remember.

T or F 6. CHI patients usually can remember information that is presented to them at the beginning and at the end of an event. They have the most difficulty remembering information which is presented to them in the middle of an event.

T or F 7. CHI patients usually have the same amount of difficulty remembering verbal information as they do remembering visual information.

T or F 8. People who have a Closed Head Injury have no problem remembering events which happened to them before the injury.

T or F 9. People who have a Closed Head Injury may have difficulty remembering events which happened to them after the injury.

T or F 10. People with Closed Head Injury often have decreased overall intelligence after their injury.

T or F 11. People with Closed Head Injuries perform tasks slower than they did before their injury.

T or F 12. CHI patients rarely have difficulty answering simple yes/no questions about words and sentences.

T or F 13. The role you have been asked to play during this experiment has you trying to put forth the best effort you can and to perform as well as you can on the memory tests which will follow.

T or F 14. In the scenario you were given, you will lose money because you will be unable to work at your lucrative job if it appears that you have real memory problems.

T or F 15. In the scenario you were given, you will be allowed to continue working at your lucrative job if it appears that your memory is normal.

T or F 16. The role you have been asked to play during this experiment has you trying to fake the most severe but believable memory problems as you can on the memory tests which will follow.

T or F 17. In the scenario you were given, you will stand to gain a large sum of money in damages from the other driver if you are successful at faking the most severe but believable memory problems you can.

T or F 18. In the scenario you were given, you will be embarrassed if you are unsuccessful at faking the most severe but believable memory problems that you can.

APPENDIX B
EXPERIMENTAL MATERIALS

Word Stem Completion Stimuli

Buffer Items

HOLIDAY	Contain the letter "D". (Y)
FERRY	The boy's mother applied a _____ to his cut. (N)
CANCER	Contain the letter "R". (Y)
BALLOON	The _____ signed the historic document at the conference. (N)
IMPRESS	Contain the letter "E". (Y)

List A Target Words

IMMENSE	The farmer hooked up the _____ to his tractor. (N)
SUPPLY	Contain the letter "U". (Y)
PERSON	Contain the letter "F". (N)
SCOPE	The doctor looked through a _____ into the patient's ear. (Y)
OBSCENE	Contain the letter "N" (Y)
TRAIN	The _____ left Grand Central Station. (Y)
RANGER	Contain the letter "B". (N)
CONCEPT	The student could not understand the _____. (Y)
REVENGE	Contain the letter "W". (N)
SPENT	The players were ready to begin the _____. (N)

List B Target Words

GRAPE	The juice of a _____ may be used to make wine. (Y)
STOCK	Contain the letter "O". (Y)
PRODUCE	Contain the letter "L". (N)
FATIGUE	It must be 100 _____ out here today. (N)
HANGAR	The old movie is a _____ (N).
ASSUME	You _____ too much by not asking for my permission. (Y)
CHEESE	Contain the letter "H". (Y)
FRESH	Contain the letter "O". (N)
SANDWICH	Contain the letter "D". (Y)
SHOULDER	The family was glad to have returned to their _____. (N)

Perceptual Identification Stimuli

Buffer Items

CORPSE	The tourist had to _____ his passport to customs officials. (N)
LOCATE	Contain the letter "D". (N)
RELAX	The _____ was rolled out to the launchpad. (N)
BURGLAR	Contain the letter "G". (N)
MEDAL	The President pinned the _____ on the hero. (Y)

Target Words

CAPTAIN	Contain the letter "P". (Y)
INDEX	Will you pick up a carton of eggs at the _____? (N)
SHARE	Contain the letter "T". (N)
BLANKET	Contain the letter "A". (Y)
REGARD	The running back scored a _____ during Sunday's game. (N)
SCARLET	The ruby was a bright _____ color. (Y)
EXPECT	What did you _____ me to say? (Y)
FLORIST	Contain the letter "B". (N)
OFFICER	The Army _____ barked his orders to the platoon. (Y)
HARVEST	The poor farmers needed a bountiful fall _____. (Y)
TENNIS	Contain the letter "S". (Y)
THIRD	Contain the letter "K". (N)
BELCH	The millionaire lived a life of luxury and _____. (N)
DESIGN	The architect will _____ a new office builing. (Y)
SENTRY	The swimmer came in _____ place in the race. (N)
GROWTH	Contain the letter "W". (Y)
APPEAL	Contain the letter "E". (Y)
ACCESS	Contain the letter "P". (N)
MUSKET	The old haunded mansion was _____. (N)
PULLEY	Contain the letter "M". (N)

Distractor Words

SPADE	PASSIVE
PLANE	COUNCIL
WORTH	SALMON
COMPLEX	QUIET
SLANG	AFFIRM
QUART	CHARGE
GENDER	MANAGER
FOREST	BLUNT
BROTHER	POLICE
SOLACE	DELAY

Free Recall Stimuli

Buffer Items

GARMENT	She picked up her _____ at the laundry. (Y)
BANDAGE	Contain the letter "L". (N)
ADOPT	Contain the letter "E". (N)
GLOVE	Contain the letter "N". (N)
CATALOG	He ordered the present from the _____. (Y)

Target Stimuli

PRICE	The _____ of the new car was too expensive. (Y)
STRESS	The man bought the _____ at the store. (N)
ADJUST	Contain the letter "J". (Y)
BLOOM	Contain the letter "S". (N)
PARENT	They ordered ham and _____ for breakfast. (N)
RETAIN	Contain the letter "I". (Y)
BASIN	Contain the letter "C". (N)
HEROIN	The secretary made two _____ of the original. (N)
SKIRT	The woman's pleated _____ matched her blouse. (Y)
TRUTH	Contain the letter "H". (Y)
DRAGON	The knight killed the _____ with his sword. (Y)
CAREER	Contain the letter "T". (N)
WINDOW	The open _____ was causing a draft. (Y)
SERVE	Will you please _____ me some food? (Y)
SOURCE	Contain the letter "F". (N)
DEFECT	The _____ opened his shop for business. (N)
CLAIM	Contain the letter "L". (Y)
THROAT	The boys tossed the _____ around the sandlot. (N)
CALORIE	Contain the letter "O". (Y)
POSITIVE	Contain the letter "B". (N)

Multiple Choice Recognition Stimuli

Buffer Items	
BARGAIN	The _____ became enraged and violent. (N)
ABSENT	Contain the letter "R". (N)
MASSAGE	The _____ parlor was closed by the police. (Y)
ABOLISH	Contain the letter "F". (N)
IMPRESS	John tried to _____ his girlfriend with his money. (Y)

Target Stimuli	
TRIAL	Contain the letter "R". (Y)
STAFF	The Chief of _____ met with the President today. (Y)
INCOME	The _____ crept up and killed the mouse. (N)
BEARD	The man's _____ needed trimming. (Y)
HEALTH	Contain the letter "T". (N)
PRAISE	Contain the letter "I". (Y)
SHELF	Contain the letter "H". (Y)
DENTIST	Contain the letter "O". (N)
PRESS	The reporter showed his _____ pass to the guard. (Y)
UNION	Contain the letter "U". (Y)
REACH	Contain the letter "D". (N)
SCRATCH	Contain the letter "K". (N)
REJECT	The negotiator will _____ the latest contract offer. (Y)
ADVERB	Contain the letter "J". (N)
SNAIL	The couple decided to have their picnic on the _____. (N)
CLERGY	People who belong to the _____ should be moral. (Y)
THEORY	The soldier was a true _____ of the U.S.A. (N)
PATTERN	Contain the letter "G". (N)
PENDANT	The _____ slowly pulled away from the funeral. (N)
MARRIAGE	The boy hated eating _____ and onions for dinner. (N)

Symptom Validity Testing Stimuli

Trial#	Target String	Answer Label	Foil String
1, 51	8160833	B	6589769
2, 52	2290337	A	5329504
3, 53	3360583	A	8295417
4, 54	6655834	A	1325078
5, 55	1111512	A	6207291
6, 56	8335511	B	3581021
7, 57	7899177	B	2983969
8, 58	9775011	A	4731265
9, 59	1113297	B	4176819
10, 60	7711331	A	8738438
11, 61	4415925	A	3980317
12, 62	5933666	B	4672506
13, 63	9276322	A	6930376
14, 64	7896322	B	2656376
15, 65	5424788	A	8739490
16, 66	2630344	A	1804647
17, 67	8087955	B	3106950
18, 68	9871799	B	4835494
19, 69	5569401	A	4048413
20, 70	1196953	A	2109312
21, 71	6606220	A	9818751
22, 72	8819392	A	7159095
23, 73	1365033	A	4278304
24, 74	5518403	A	6142347
25, 75	1575688	B	4539021
26, 76	2058422	B	7151515
27, 77	2288097	B	5086712
28, 78	3770399	A	4924285
29, 79	5416977	B	2751389
30, 80	4072099	B	7640491
31, 81	7771260	A	6442532
32, 82	3367623	B	2380109
33, 83	2498788	B	5651732
34, 84	4203177	A	3980617
35, 85	7721728	B	6893924
36, 86	9587833	B	8426731
37, 87	6645301	B	9296568
38, 88	8868519	A	1453070
39, 89	7569766	B	8724680
40, 90	5540784	B	8903816
41, 91	4182444	B	5986154

Symptom Validity Testing Stimull (continued)

Trial#	Target String	Answer Label	Foil String
42, 92	2291658	A	7153897
43, 93	4431908	A	1732267
44, 94	4430681	B	9462073
45, 95	1394844	B	6254262
46, 96	3563666	B	4152643
47, 97	9955251	A	4836759
48, 98	6405655	A	7851563
49, 99	3372417	A	8451201
50, 100	3015355	B	8276524

APPENDIX C
POSTEXPERIMENTAL MATERIALS

De-Briefing Rating Sheet

For each task that you participated in during the experiment, please rate the (1) effort you put into playing your role; (2) the difficulty of the task for playing your role; and (3) how successful/unsuccessful you think you were in responding according to your role. Use the following 7-point scales.

Effort

1	2	3	4	5	6	7
Minimum effort			Average effort			Maximum effort

Difficulty of Task
(if you would have been performing your best)

1	2	3	4	5	6	7
Minimum difficulty			Average difficulty			Maximum difficulty

Success of Performing your Role

1	2	3	4	5	6	7
Minimum success			Average success			Maximum success

Effort	Diffi-culty	Succ-ess??	
____	____	____	1. Remembering stories immediately after having heard them.

____	____	____	2.	Remembering stories a few minutes after having heard them.
____	____	____	3.	Drawing simple geometric designs immediately after having studied them for 10 seconds.
____	____	____	4.	Drawing simple geometric designs a few minutes after having studied them.
____	____	____	5.	Studying digits on the computer screen and then choosing which one you studied from two choices.
____	____	____	6.	Copying the complex geometric figure while looking at it.
____	____	____	7.	Drawing the complex geometric figure from memory immediately after having copied it.
____	____	____	8.	Drawing the complex geometric figure from memory a few minutes after having copied it.
____	____	____	9.	Remembering the Monday Shopping List immediately after having been read it.
____	____	____	10.	Remembering the Monday Shopping List <u>when given hints</u> immediately after having read it.
____	____	____	11.	Remembering the Monday Shopping List a few minutes after having read it.
____	____	____	12.	Remebering the Monday Shopping List <u>when given hints</u> a few minutes after having been read it.
____	____	____	13.	Picking Monday Shopping List items out of a larger list of shopping items.
____	____	____	14.	Answering simple questions about personal and current information.

____	____	____	15.	Remembering digits immediately after having been read them.
____	____	____	16.	Remembering digits <u>in the reverse order</u> immediately after having been read them.
____	____	____	17.	Remembering words paired together.
____	____	____	18.	Answering simple yes/no questions about words and sentences.
____	____	____	19.	Completing 3 letter word stems with the first words that came to mind.
____	____	____	20.	Identifying words that flash quickly on the tachistoscope.
____	____	____	21.	Writing down on blanks all the words you can remember from a previous deck of words.
____	____	____	22.	Picking out a word from 4 alternatives the words you can remember from a previous deck of words.

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BIOGRAPHICAL SKETCH

Travis Gordon White, Jr., was born in Austin, Texas, on April 23, 1965. Upon graduation from Robert E. Lee High School in Houston, Texas, in 1983, Travis matriculated at Southern Methodist University in Dallas, Texas. While at Southern Methodist, Travis undertook an honor's thesis project titled "Environmental Potentiation of Taste Aversion Learning in Rats." Based on this research project, Travis graduated from Southern Methodist with departmental distinction in 1987.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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